EXHIBIT 17

US005842020A

United States Patent [19]

Faustini

[11] **Patent Number: 5,842,020**

[45] **Date of Patent: Nov. 24, 1998**

[54] **SYSTEM, METHOD AND ARTICLE OF MANUFACTURE FOR PROVIDING DYNAMIC USER EDITING OF OBJECT ORIENTED COMPONENTS USED IN AN OBJECT ORIENTED APPLET OR APPLICATION**

[75] Inventor: **Antony Azio Faustini**, Palo Alto, Calif.

[73] Assignee: **Sun Microsystems, Inc.**, Palo Alto, Calif.

[21] Appl. No.: **792,242**

[22] Filed: **Jan. 31, 1997**

[51] **Int. Cl.**[6] **G06F 9/445**

[52] **U.S. Cl.** **395/701**; 395/702; 345/333; 345/334; 345/340; 345/967

[58] **Field of Search** 395/701, 702, 395/703; 345/333, 334, 335, 338, 339, 340, 967; 707/500, 530

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,686,522	8/1987	Hernandez et al.	340/709
4,813,013	3/1989	Dunn	364/900
4,901,221	2/1990	Kodosky et al.	364/200
4,914,568	4/1990	Kodosky et al.	364/200
5,291,587	3/1994	Kodosky et al.	395/500
5,301,301	4/1994	Kodosky et al.	395/500
5,301,336	4/1994	Kodosky et al.	395/800
5,315,703	5/1994	Matheny et al.	395/164
5,367,633	11/1994	Matheny et al.	395/164
5,386,568	1/1995	Wold et al.	395/700
5,388,264	2/1995	Tobias, II et al.	395/650
5,485,617	1/1996	Stutz et al.	395/700
5,487,141	1/1996	Cain et al.	395/135
5,517,645	5/1996	Stutz et al.	395/700
5,553,227	9/1996	Berry	395/161
5,555,370	9/1996	Li et al.	395/161
5,572,648	11/1996	Bibayan	395/340
5,574,918	11/1996	Hurley	395/561
5,586,319	12/1996	Bell	395/701
5,640,566	6/1997	Victor et al.	395/701
5,675,803	10/1997	Preisler et al.	395/704

OTHER PUBLICATIONS

"First Look : Super Cede JAVA Edition", Asymetrix's Corporation, 1996 pp. 18–29.

Dan Joshi, Laura Lemay, and Charles Perkins, *teach Yourself Java in Café* in 21 Days, pp. 292–322, U.S.A.

George Shepherd, Visual C++ 5.0 Simplifies the Process for Developing and Using COM Objects, Microsoft Systems Journal, May 1997, vol. 12, No. 5, pp. 37–47, U.S.A.

Gess Shankar, *Web application development environment*; Hahtsite: Enterprise–class tool, InfoWorld, Mar. 17, 1997, Intranet World, p. 54a, U.S.A.

Herb Bethoney, HAHTSite Gives Pros Everything They Need, PC Week, Mar. 10, 1997, p, 36, U.S.A.

Maggie Biggs, BETA; *Java development tool; Mojo working on data support*, InfoWorld, Feb. 3, 1997, Intranet World, p. 1W/1, U.S.A.

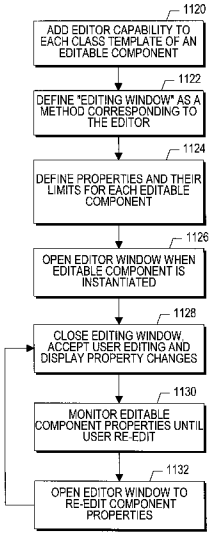
Maggie Biggs, Penumbra's got its Mojo working for Java based apps, InfoWorld, Nov. 18, 1996, vol. 18, No. 47, p. 1W4; ISSN: 0199–6649, U.S.A.

Primary Examiner—Emanuel Todd Voeltz
Assistant Examiner—Kakali Chaki
Attorney, Agent, or Firm—Beyer & Weaver, LLP

[57] **ABSTRACT**

Method, system and article of manufacture for dynamic editing of object oriented components used in an object oriented applet or application. An editor window is defined in predetermined class templates as a method corresponding to the editor. Then, when a component is instantiated from one of said predetermined classes, the editor is automatically opened to permit the user to make changes in the component's properties. When editing is completed, the editor window is closed, the changes are accepted and then displayed for the edited component. Components are thereafter monitored for a user re-editing request which, when detected, causes the editing cycle to be initiated.

20 Claims, 32 Drawing Sheets



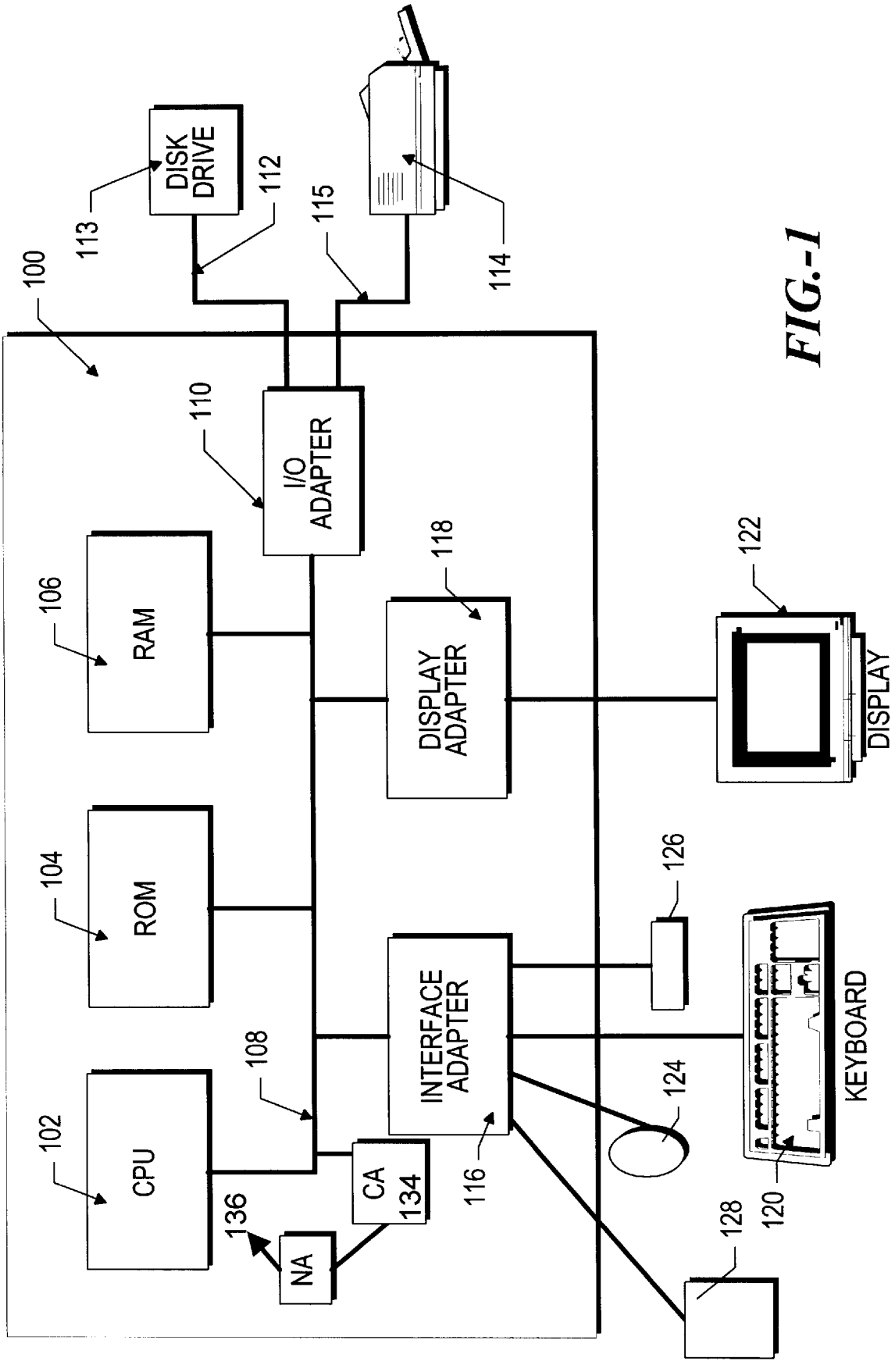

DISK DRIVE
113
112
115
114
100
110
I/O ADAPTER
106
RAM
118
DISPLAY ADAPTER
122
DISPLAY
104
ROM
126
108
INTERFACE ADAPTER
124
KEYBOARD
102
CPU
CA
134
116
120
136
NA
128

FIG.-1

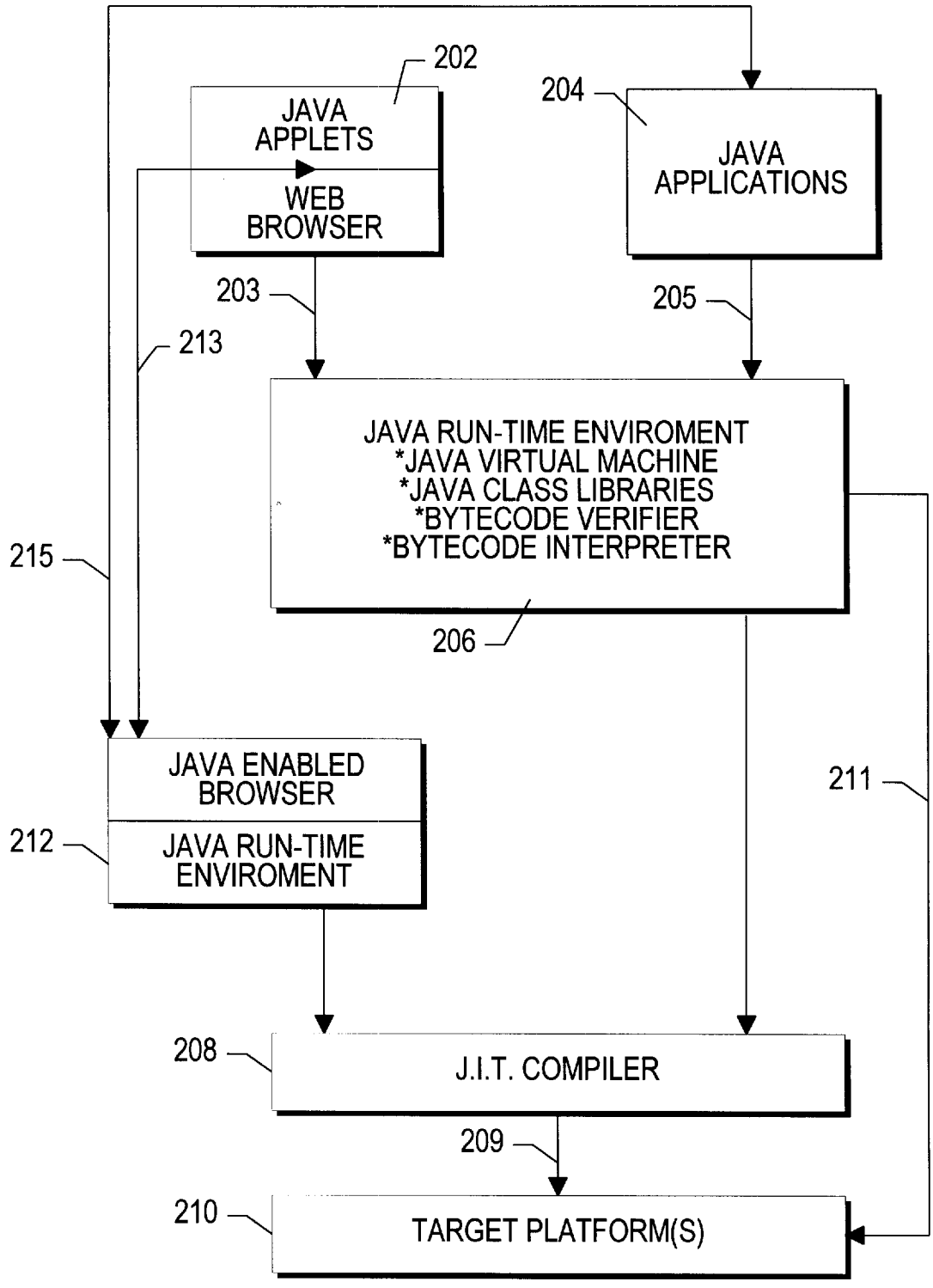

202
JAVA APPLETS
WEB BROWSER
204
JAVA APPLICATIONS
203
205
213
JAVA RUN-TIME ENVIROMENT
*JAVA VIRTUAL MACHINE
*JAVA CLASS LIBRARIES
*BYTECODE VERIFIER
*BYTECODE INTERPRETER
215
206
JAVA ENABLED BROWSER
212
JAVA RUN-TIME ENVIROMENT
211
208
J.I.T. COMPILER
209
210
TARGET PLATFORM(S)

FIG.-2

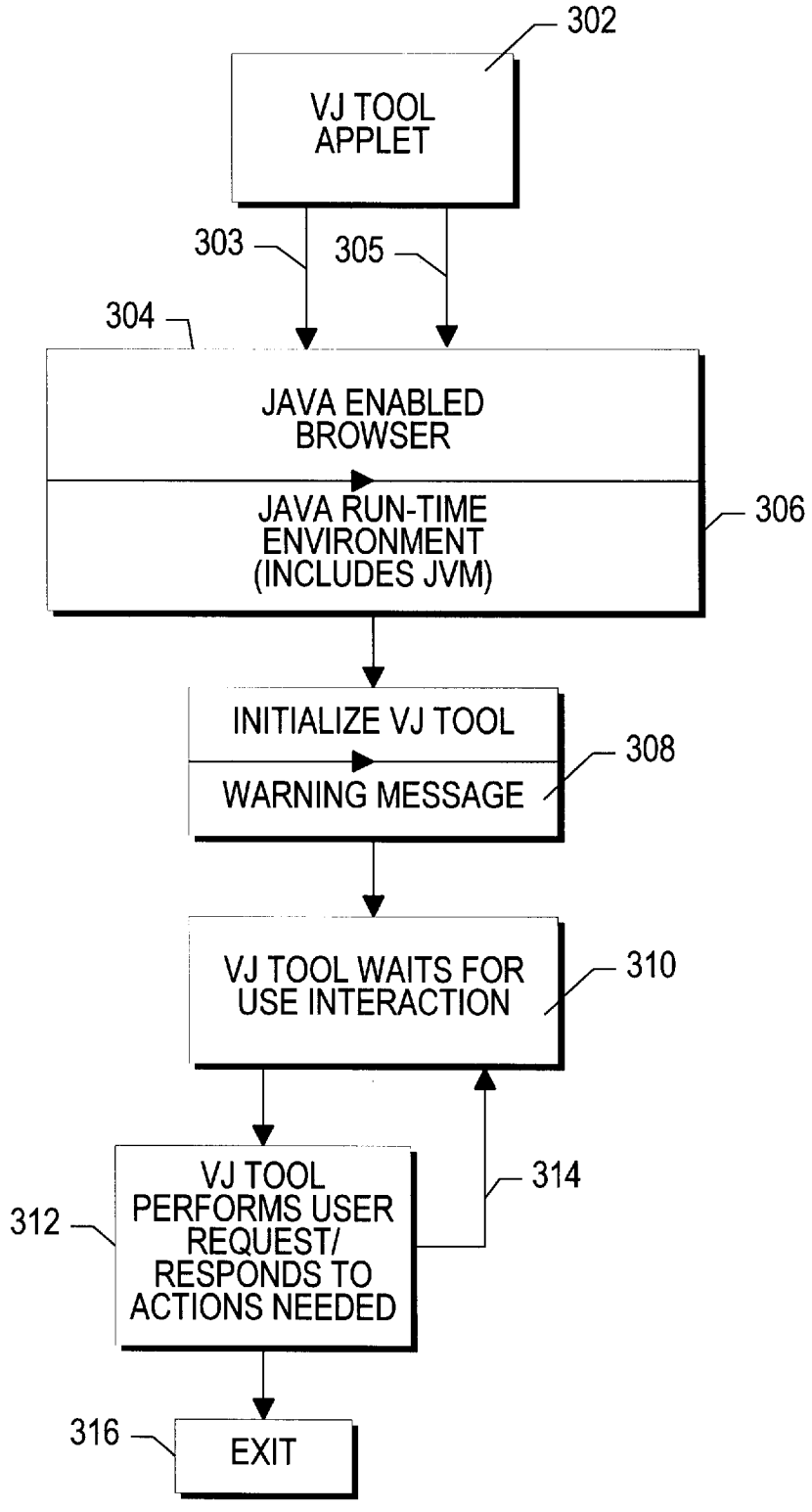

302
VJ TOOL APPLET
303
305
304
JAVA ENABLED BROWSER
JAVA RUN-TIME ENVIRONMENT (INCLUDES JVM)
306
INITIALIZE VJ TOOL
WARNING MESSAGE
308
VJ TOOL WAITS FOR USE INTERACTION
310
VJ TOOL PERFORMS USER REQUEST/ RESPONDS TO ACTIONS NEEDED
312
314
316
EXIT

FIG.-3

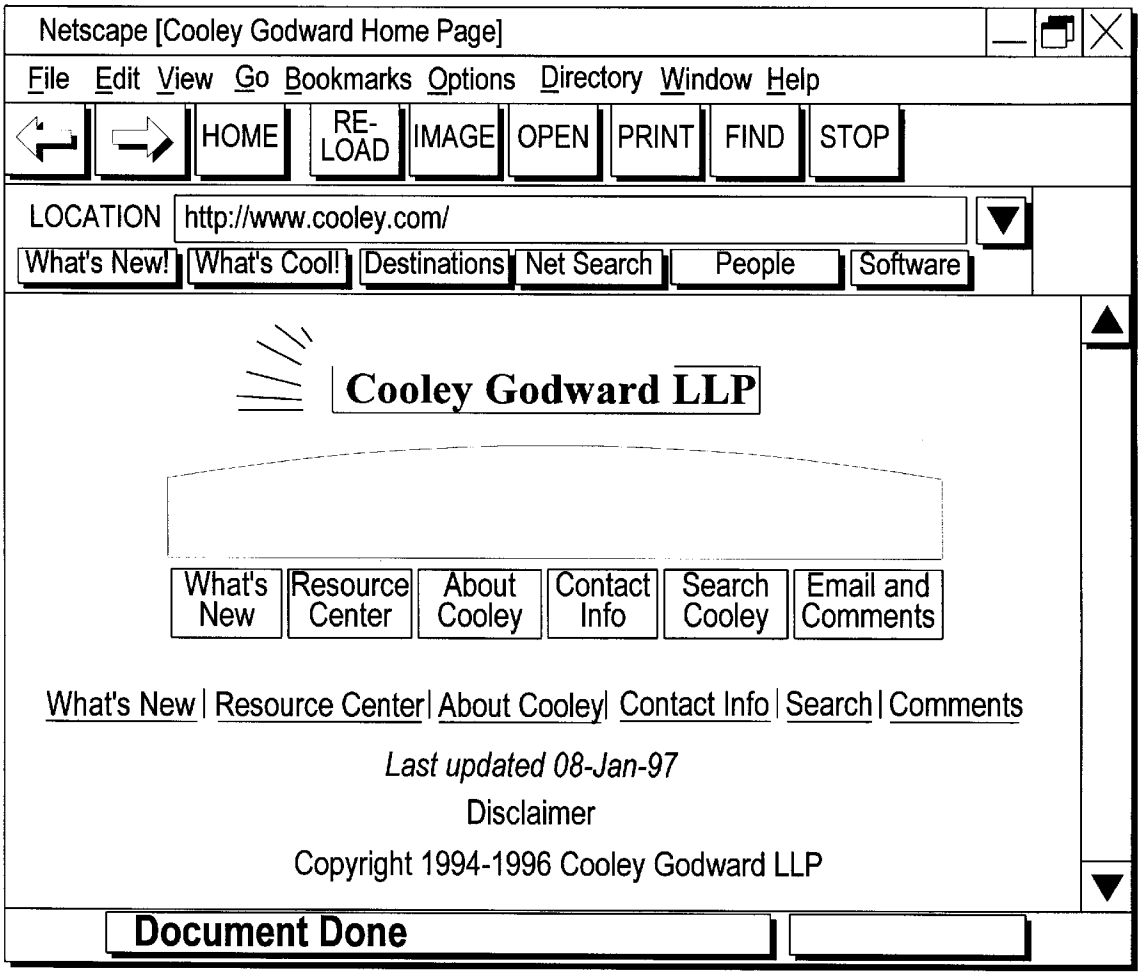

Netscape [Cooley Godward Home Page]
File Edit View Go Bookmarks Options Directory Window Help
HOME
RE-LOAD
IMAGE
OPEN
PRINT
FIND
STOP
LOCATION
http://www.cooley.com/
What's New!
What's Cool!
Destinations
Net Search
People
Software
Cooley Godward LLP
What's New
Resource Center
About Cooley
Contact Info
Search Cooley
Email and Comments
What's New | Resource Center | About Cooley | Contact Info | Search | Comments
Last updated 08-Jan-97
Disclaimer
Copyright 1994-1996 Cooley Godward LLP
Document Done

FIG.-4A

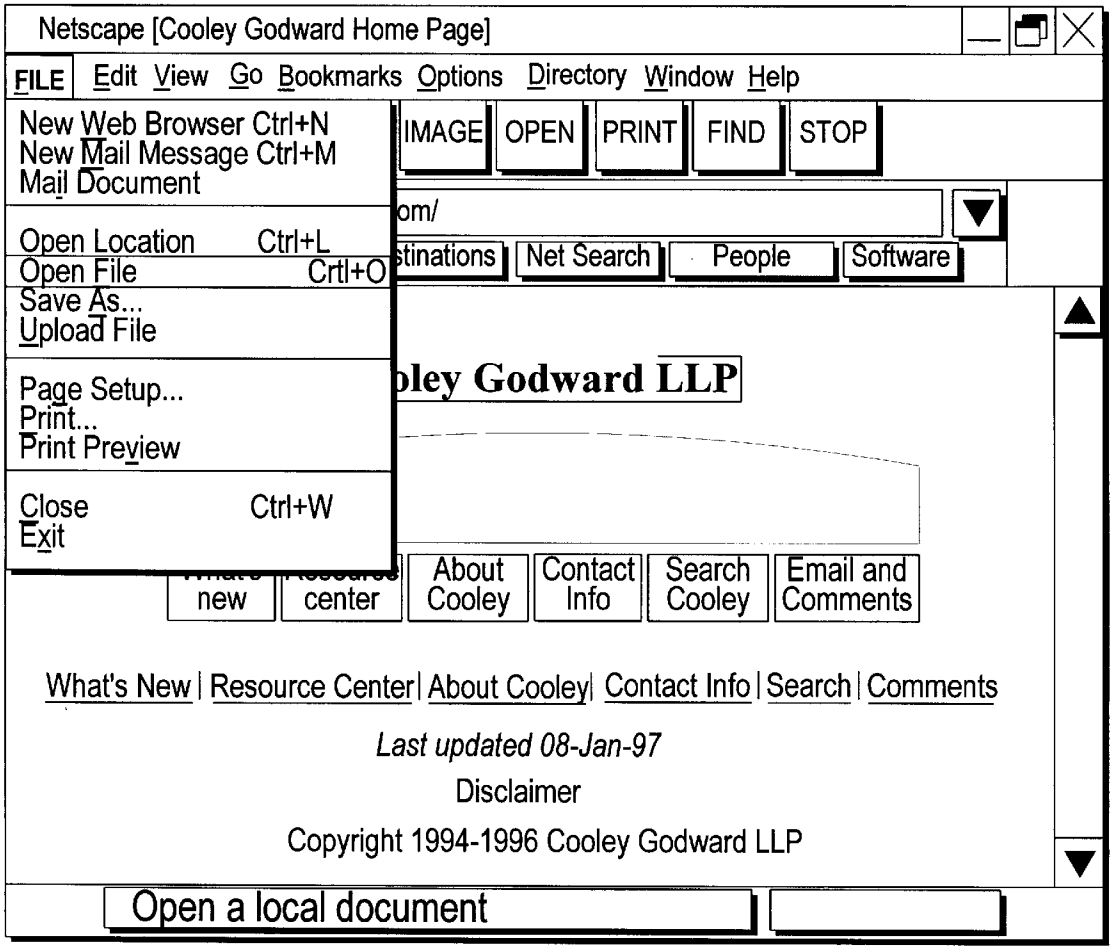

Netscape [Cooley Godward Home Page]
FILE Edit View Go Bookmarks Options Directory Window Help
New Web Browser Ctrl+N
New Mail Message Ctrl+M
Mail Document
Open Location Ctrl+L
Open File Crtl+O
Save As...
Upload File
Page Setup...
Print...
Print Preview
Close Ctrl+W
Exit
IMAGE OPEN PRINT FIND STOP
om/
Net Search People Software
oley Godward LLP
new center About Cooley Contact Info Search Cooley Email and Comments
What's New | Resource Center | About Cooley | Contact Info | Search | Comments
Last updated 08-Jan-97
Disclaimer
Copyright 1994-1996 Cooley Godward LLP
Open a local document

FIG.-4B

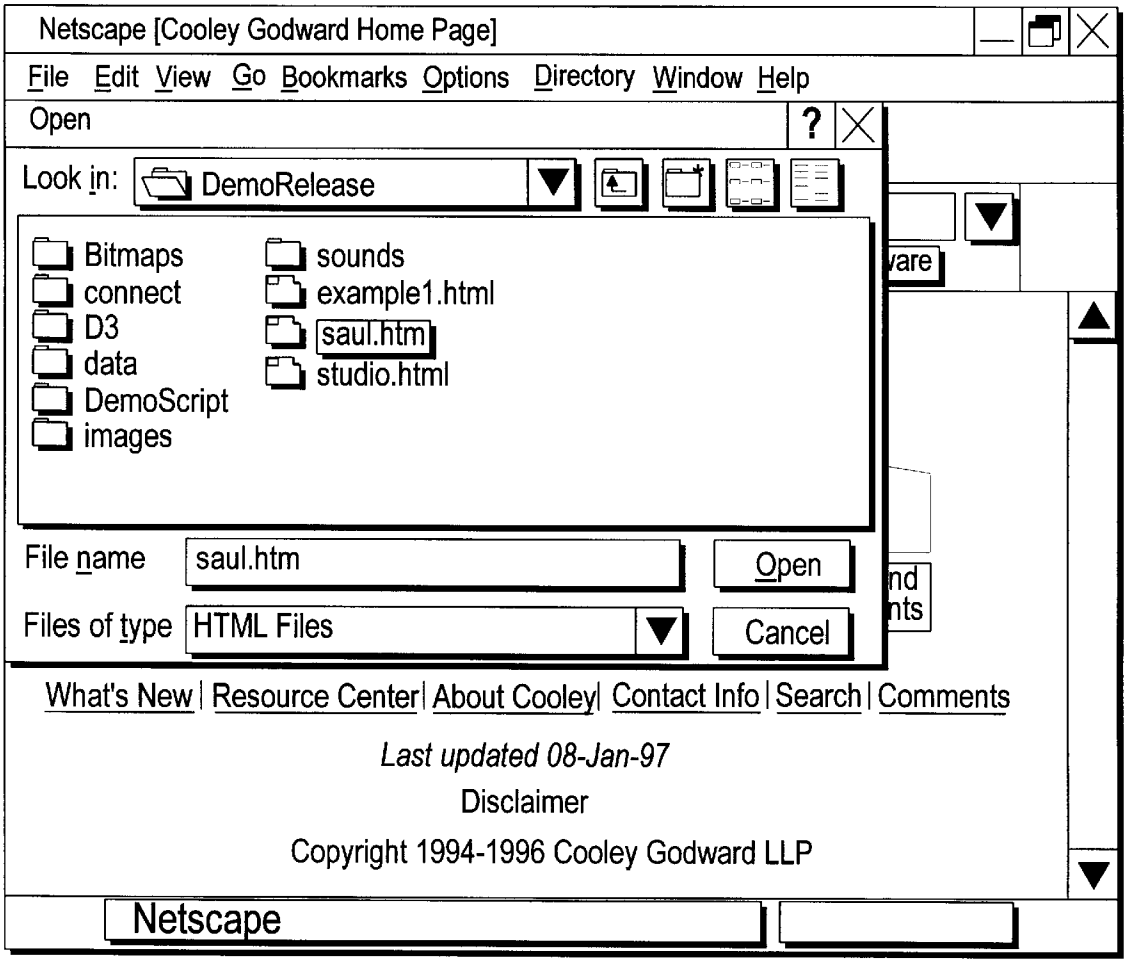

Netscape [Cooley Godward Home Page]
File Edit View Go Bookmarks Options Directory Window Help
Open
Look in: DemoRelease
Bitmaps
connect
D3
data
DemoScript
images
sounds
example1.html
saul.htm
studio.html
File name saul.htm
Open
Files of type HTML Files
Cancel
What's New | Resource Center | About Cooley | Contact Info | Search | Comments
Last updated 08-Jan-97
Disclaimer
Copyright 1994-1996 Cooley Godward LLP
Netscape

FIG.-4C

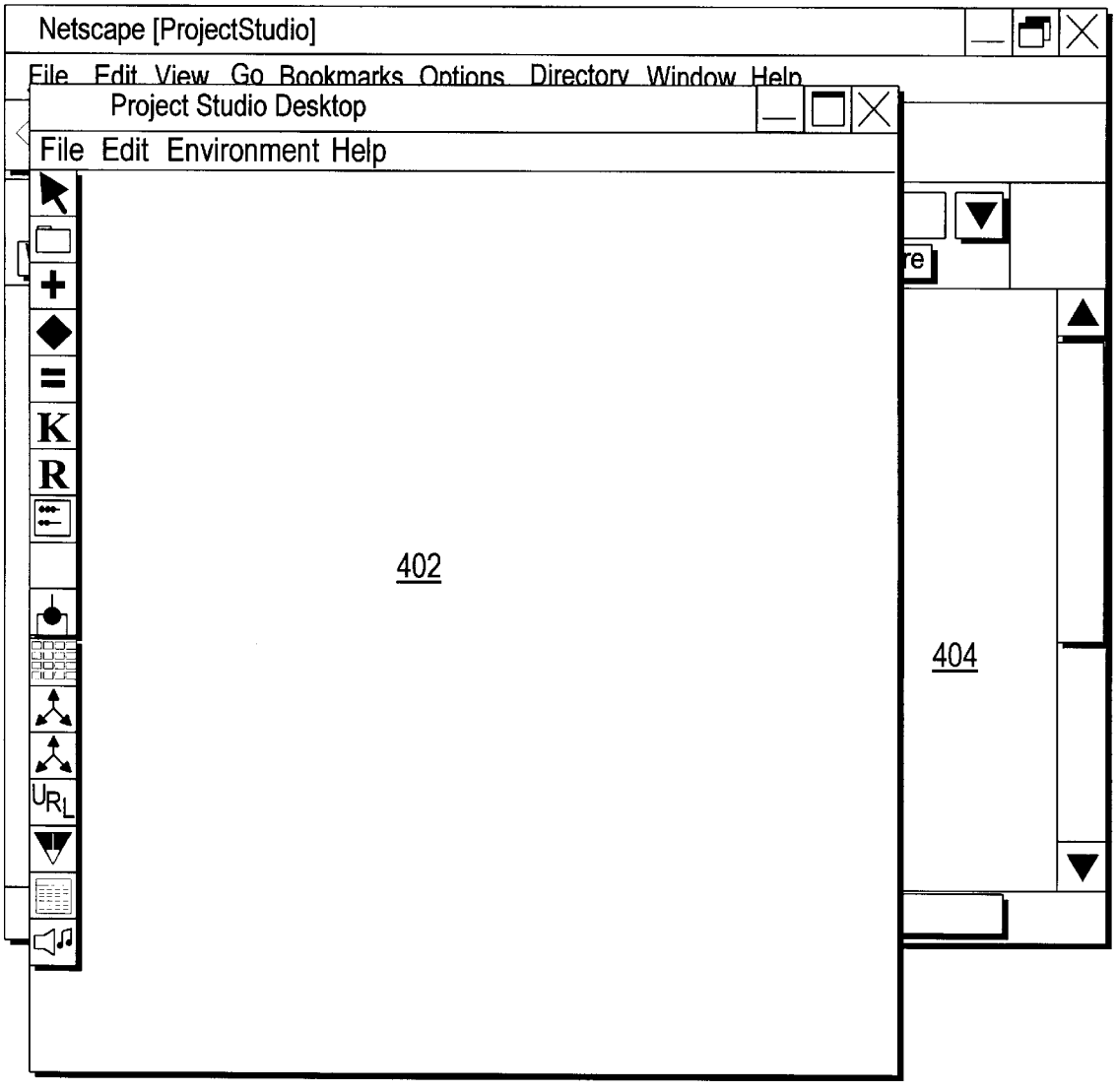

Netscape [ProjectStudio]
File Edit View Go Bookmarks Options Directory Window Help
Project Studio Desktop
File Edit Environment Help
402
404

FIG.-4D

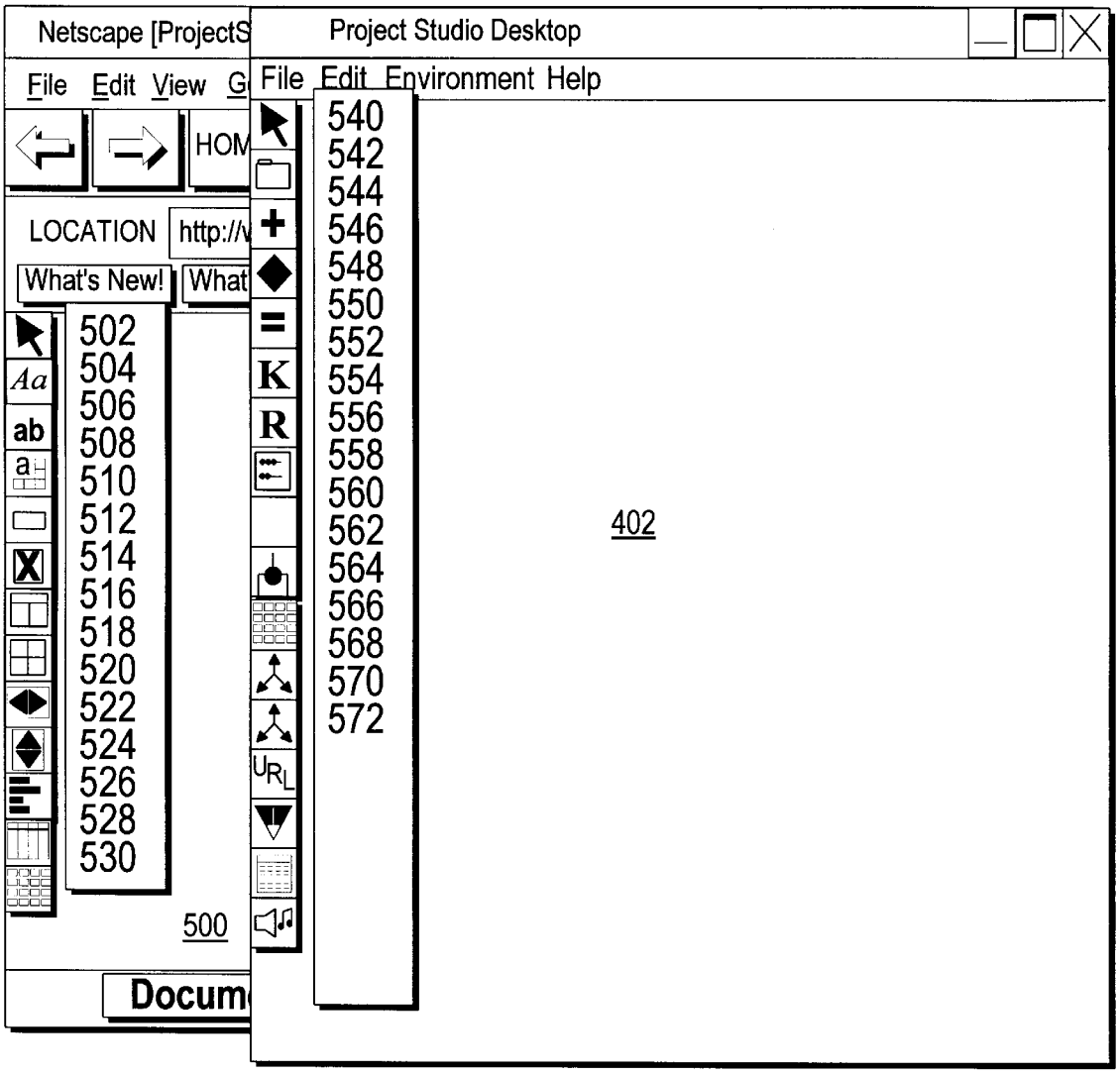

Netscape [ProjectS
File Edit View G
HOM
LOCATION http://v
What's New!
What
502
504
506
508
510
512
514
516
518
520
522
524
526
528
530
500
Docum
Project Studio Desktop
File Edit Environment Help
540
542
544
546
548
550
552
554
556
558
560
562
564
566
568
570
572
402

FIG.-5

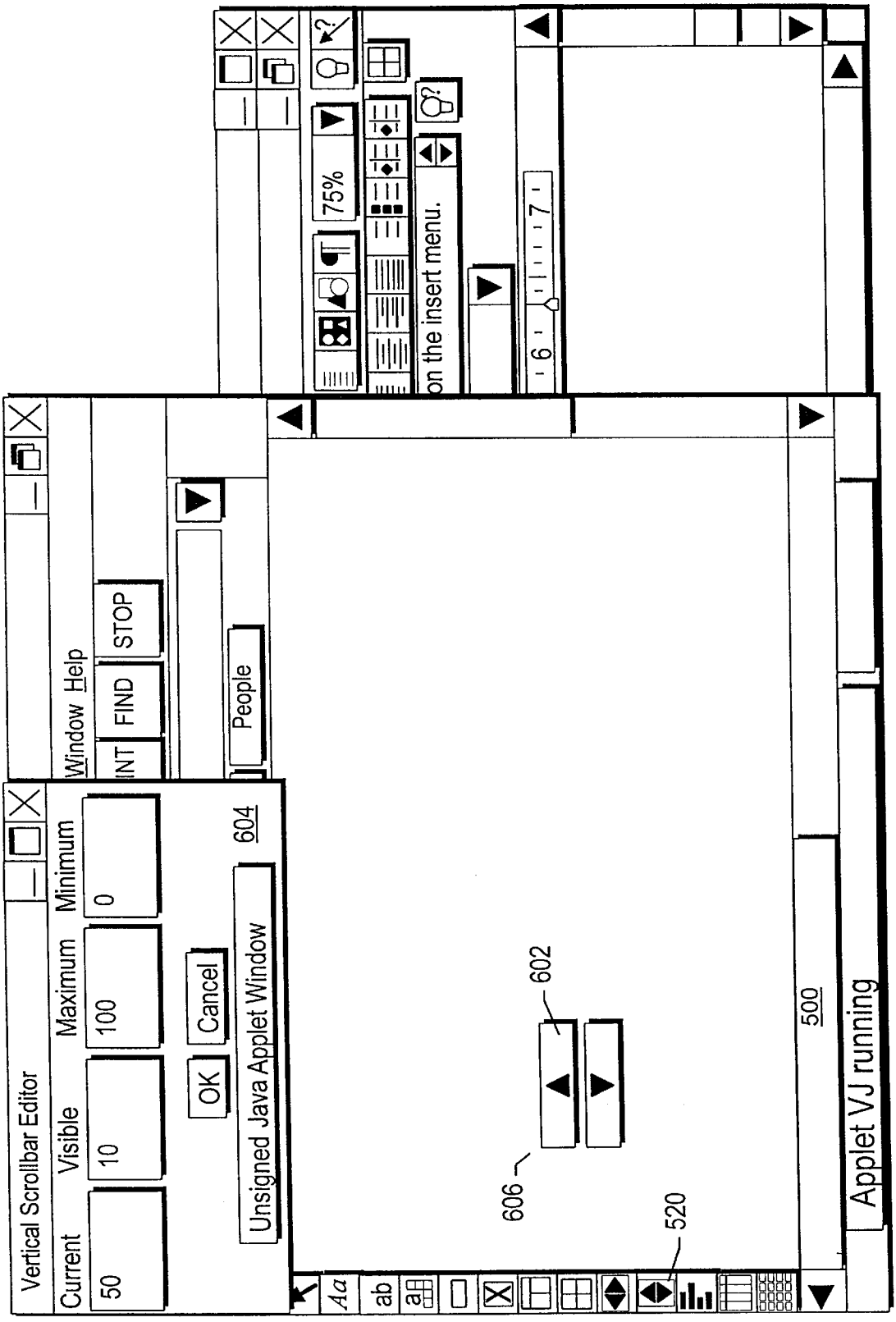

Vertical Scrollbar Editor
Current
50
Visible
10
Maximum
100
Minimum
0
OK
Cancel
Unsigned Java Applet Window
604
Window Help
INT
FIND
STOP
People
75%
on the insert menu.
602
606
520
500
Applet VJ running

FIG.-6

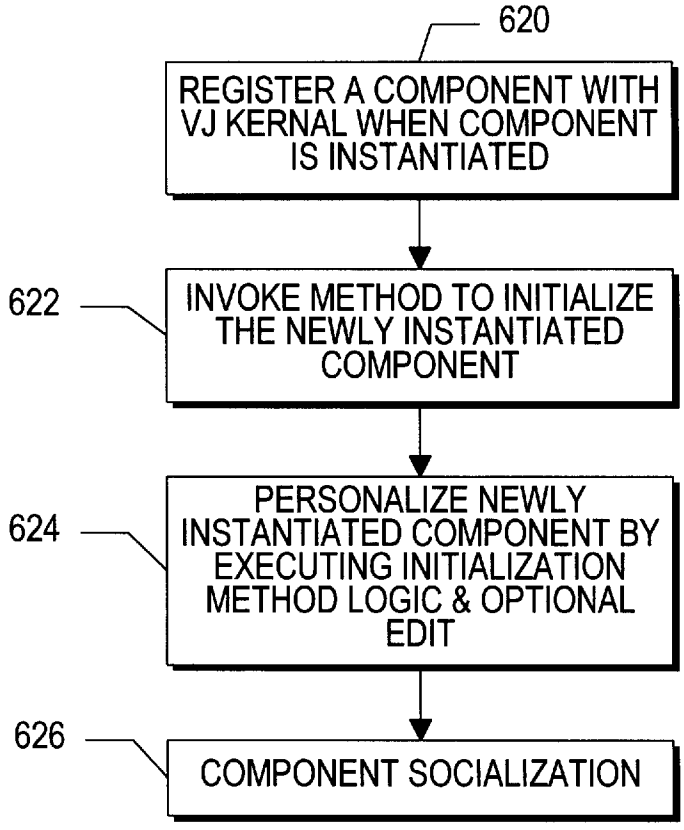

620
REGISTER A COMPONENT WITH VJ KERNAL WHEN COMPONENT IS INSTANTIATED
622
INVOKE METHOD TO INITIALIZE THE NEWLY INSTANTIATED COMPONENT
624
PERSONALIZE NEWLY INSTANTIATED COMPONENT BY EXECUTING INITIALIZATION METHOD LOGIC & OPTIONAL EDIT
626
COMPONENT SOCIALIZATION

FIG.-6A

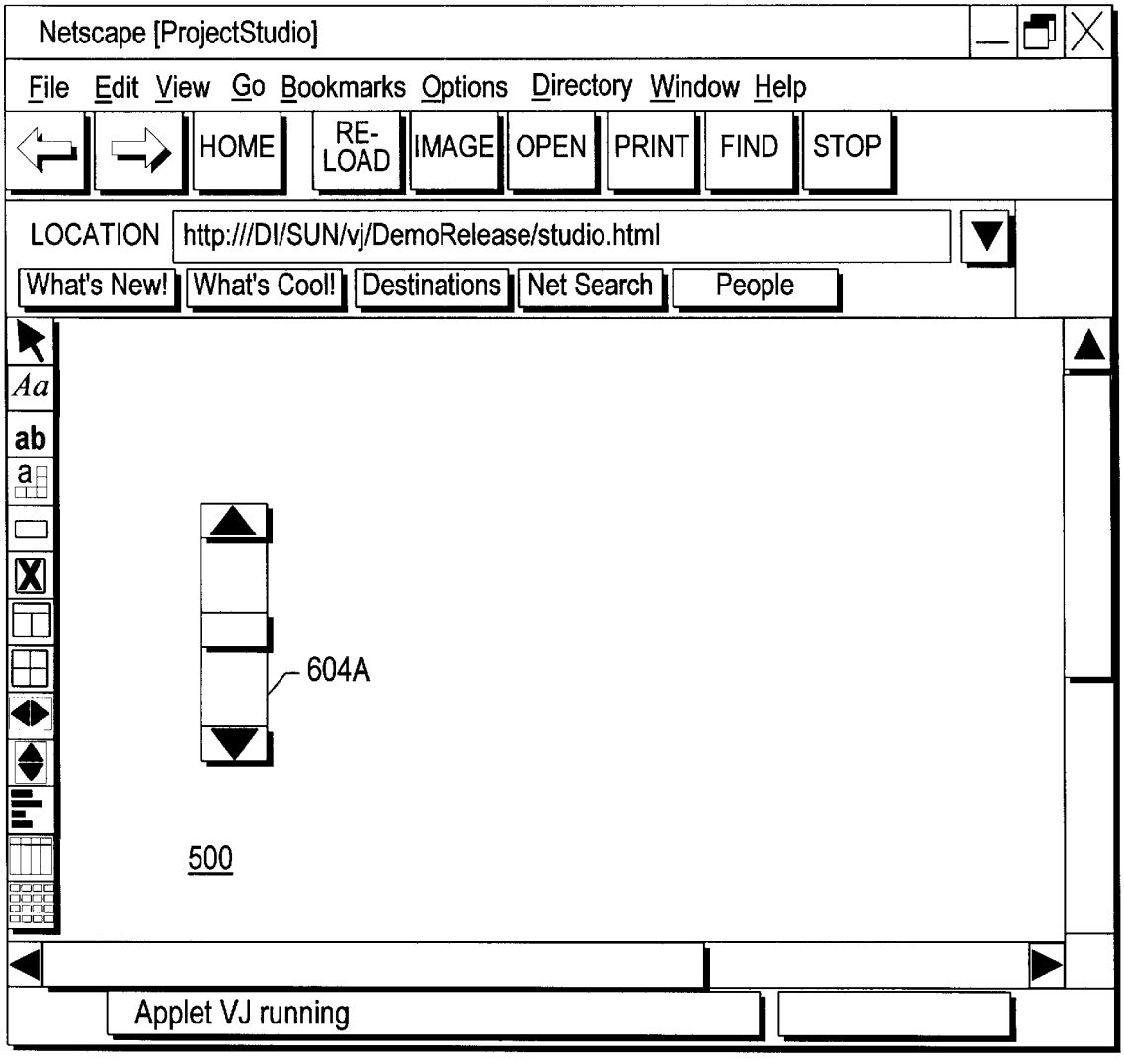
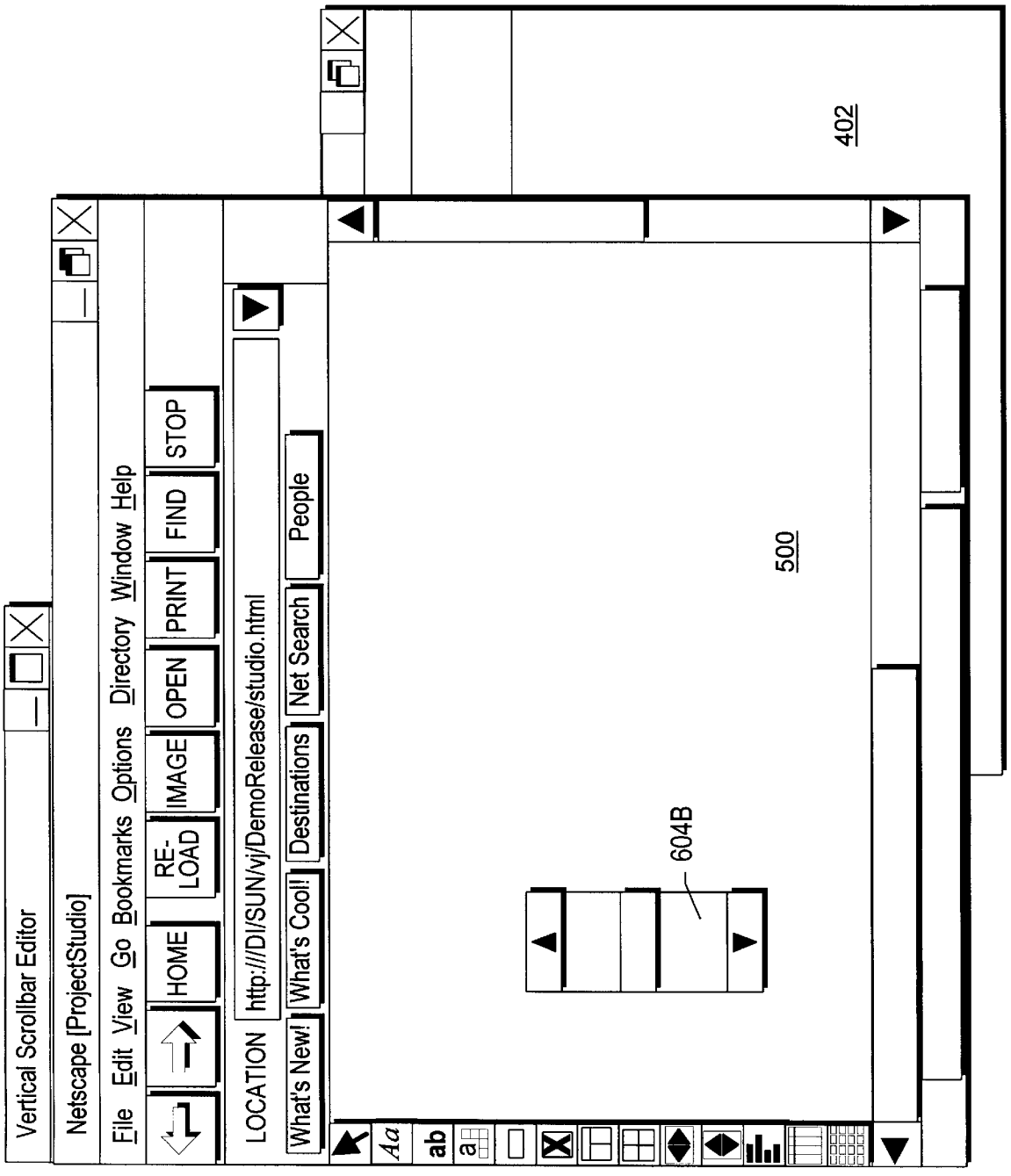

Netscape [ProjectStudio]
File Edit View Go Bookmarks Options Directory Window Help
HOME
RE-LOAD
IMAGE
OPEN
PRINT
FIND
STOP
LOCATION
http:///DI/SUN/vj/DemoRelease/studio.html
What's New!
What's Cool!
Destinations
Net Search
People
604A
500
Applet VJ running

FIG.-7

FIG.-8


Vertical Scrollbar Editor
Netscape [ProjectStudio]
File Edit View Go Bookmarks Options Directory Window Help
HOME
RE-LOAD
IMAGE
OPEN
PRINT
FIND
STOP
LOCATION
http:///DI/SUN/vj/DemoRelease/studio.html
What's New!
What's Cool!
Destinations
Net Search
People
402
500
604B

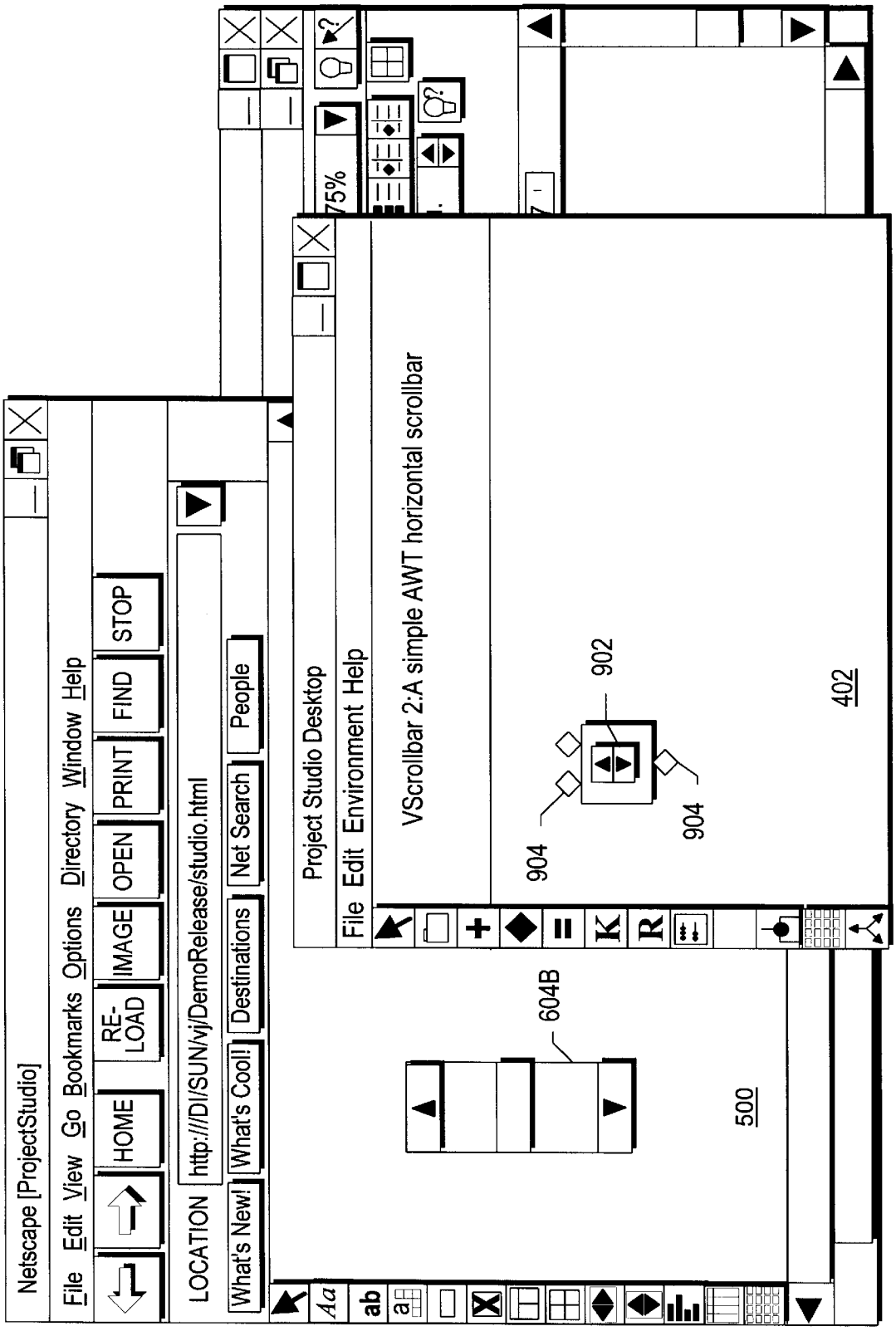

Netscape [ProjectStudio]
File Edit View Go Bookmarks Options Directory Window Help
HOME
RE-LOAD
IMAGE
OPEN
PRINT
FIND
STOP
LOCATION http:///DI/SUN/vj/DemoRelease/studio.html
What's New!
What's Cool!
Destinations
Net Search
People
Project Studio Desktop
File Edit Environment Help
VScrollbar 2:A simple AWT horizontal scrollbar
902
904
904
402
604B
500

FIG.-9

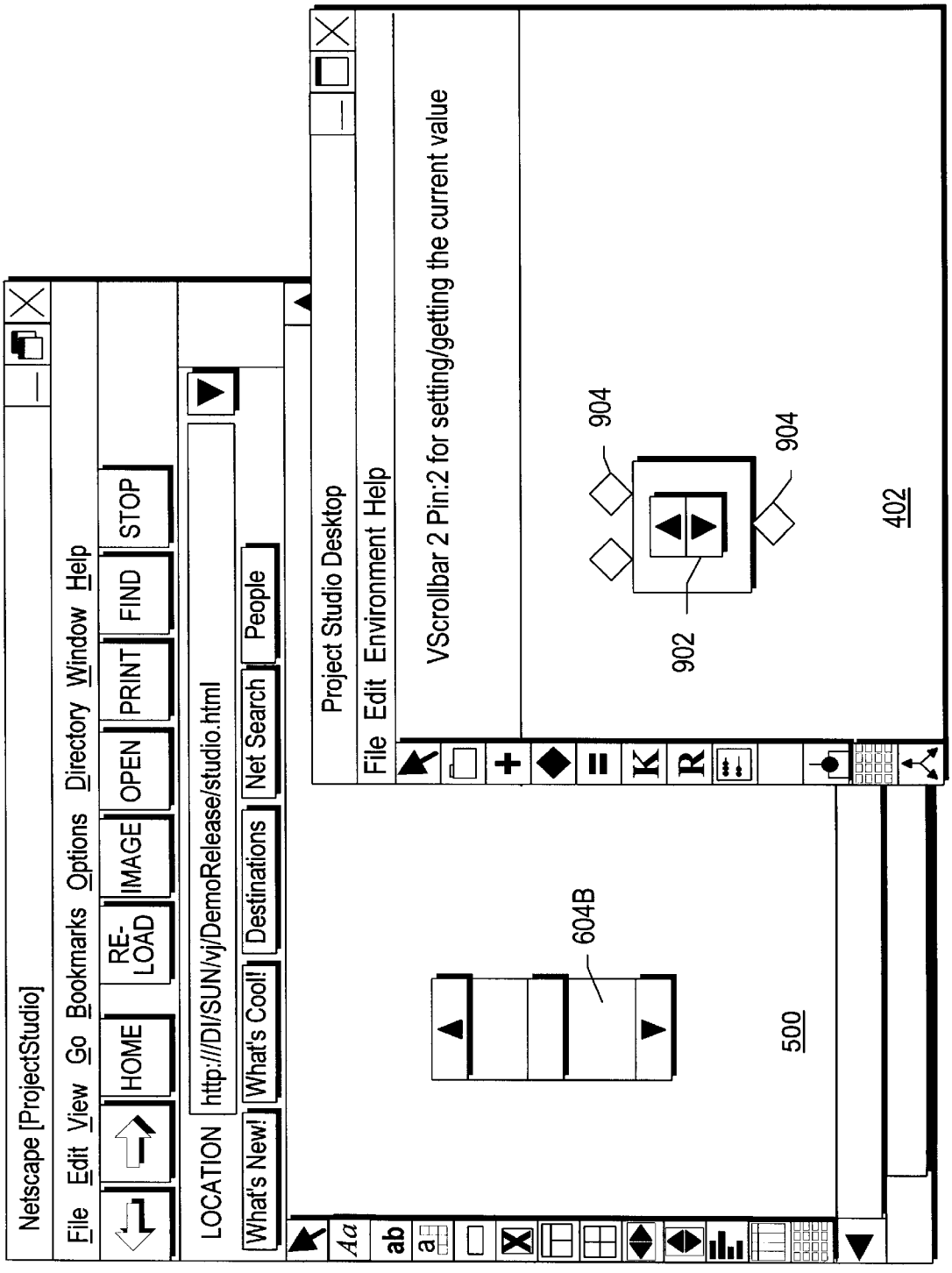

Netscape [ProjectStudio]
File Edit View Go Bookmarks Options Directory Window Help
HOME
RE-LOAD
IMAGE
OPEN
PRINT
FIND
STOP
LOCATION
http:///DI/SUN/vj/DemoRelease/studio.html
What's New!
What's Cool!
Destinations
Net Search
People
Project Studio Desktop
File Edit Environment Help
VScrollbar 2 Pin:2 for setting/getting the current value
904
902
904
402
604B
500

FIG.-10

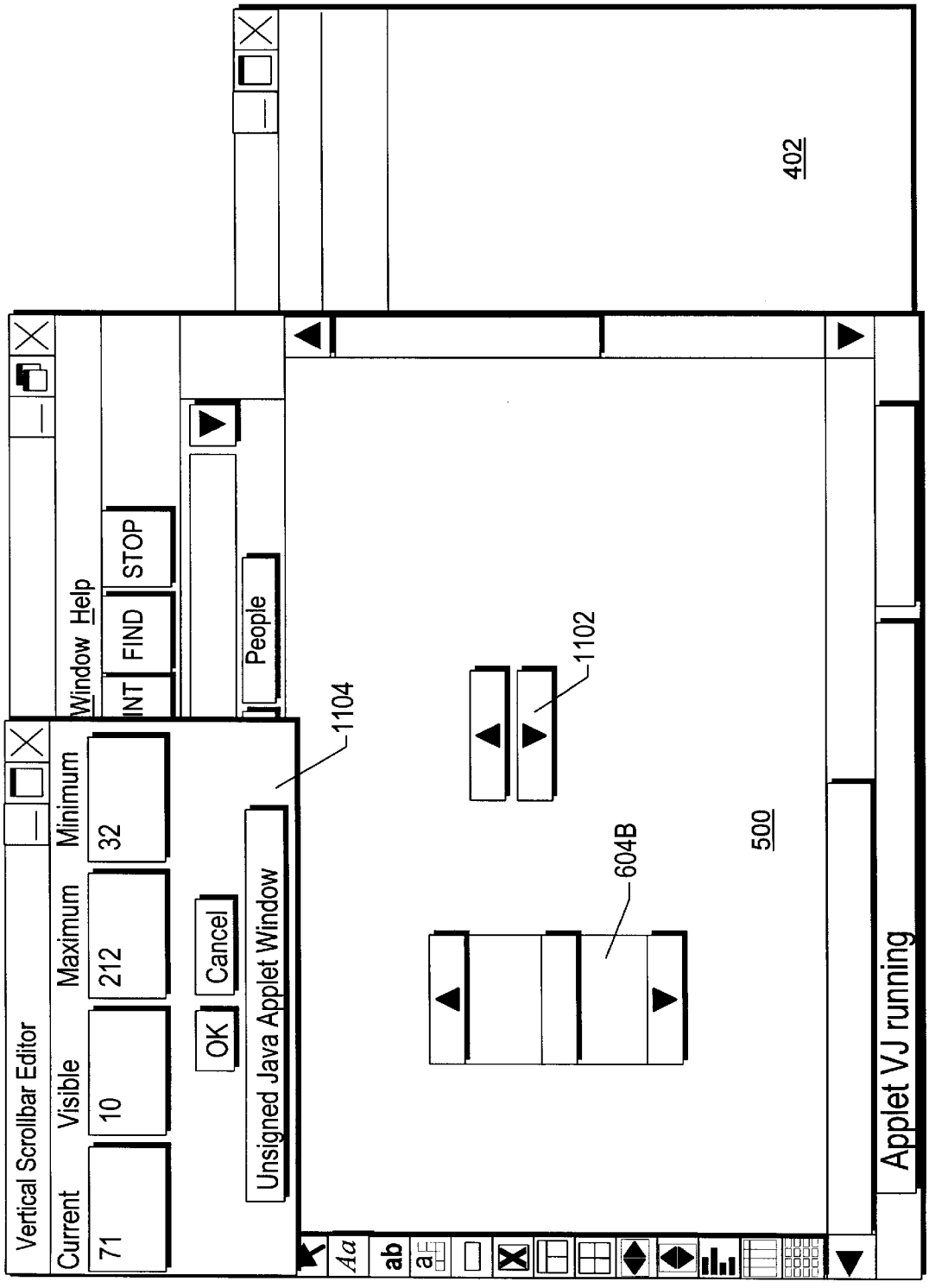

402
Window Help
STOP
FIND
INT
People
1104
1102
604B
500
Vertical Scrollbar Editor
Current
71
Visible
10
Maximum
212
Minimum
32
OK
Cancel
Unsigned Java Applet Window
Applet VJ running

FIG.-11

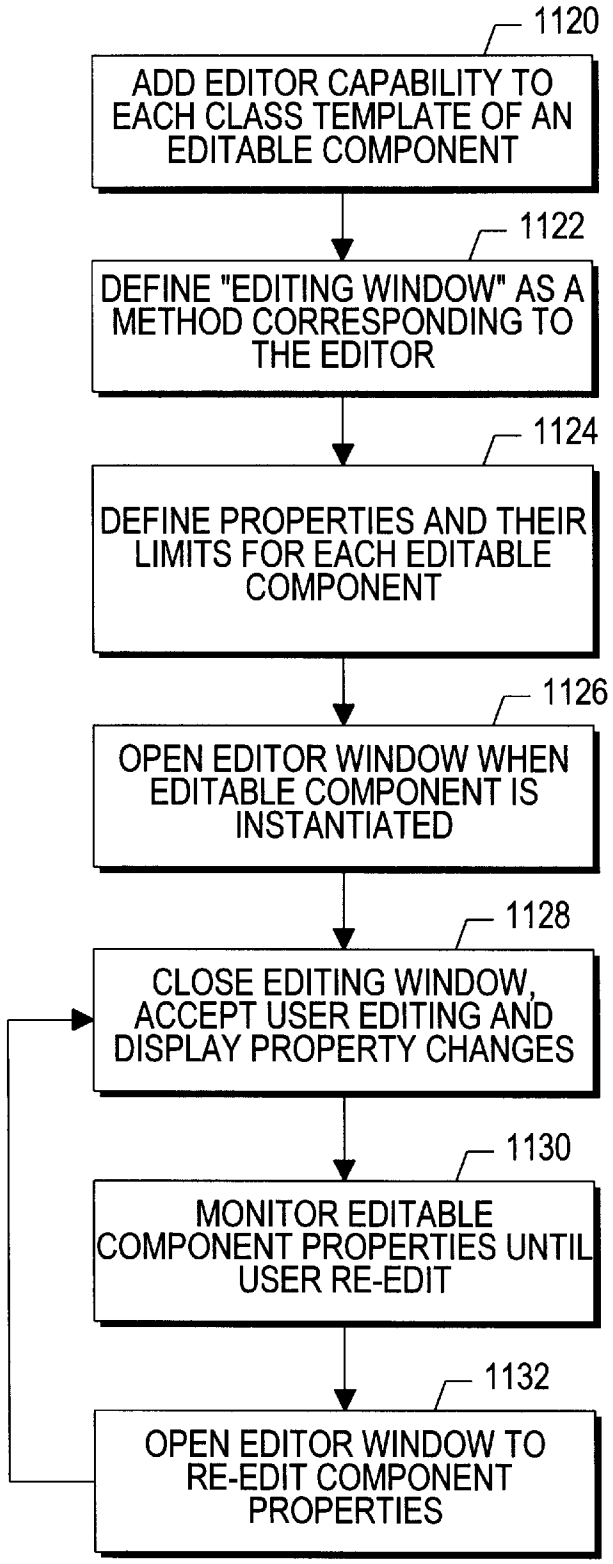

1120
ADD EDITOR CAPABILITY TO EACH CLASS TEMPLATE OF AN EDITABLE COMPONENT
1122
DEFINE "EDITING WINDOW" AS A METHOD CORRESPONDING TO THE EDITOR
1124
DEFINE PROPERTIES AND THEIR LIMITS FOR EACH EDITABLE COMPONENT
1126
OPEN EDITOR WINDOW WHEN EDITABLE COMPONENT IS INSTANTIATED
1128
CLOSE EDITING WINDOW, ACCEPT USER EDITING AND DISPLAY PROPERTY CHANGES
1130
MONITOR EDITABLE COMPONENT PROPERTIES UNTIL USER RE-EDIT
1132
OPEN EDITOR WINDOW TO RE-EDIT COMPONENT PROPERTIES

FIG.-11A

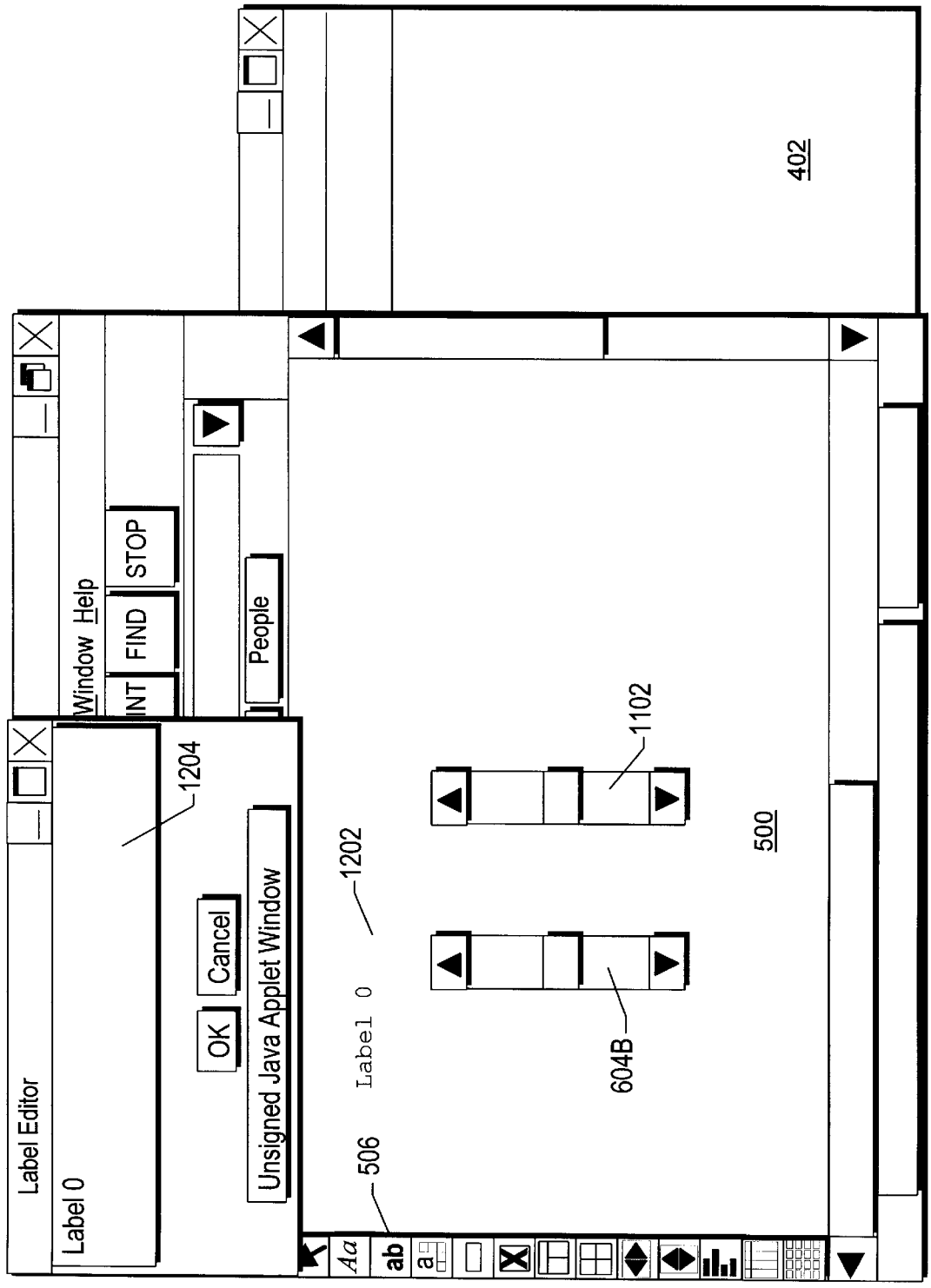

402
Window Help
STOP
FIND
INT
People
1102
1204
1202
500
Label Editor
Label 0
OK
Cancel
Unsigned Java Applet Window
Label 0
604B
506
Aa
ab

FIG.-12

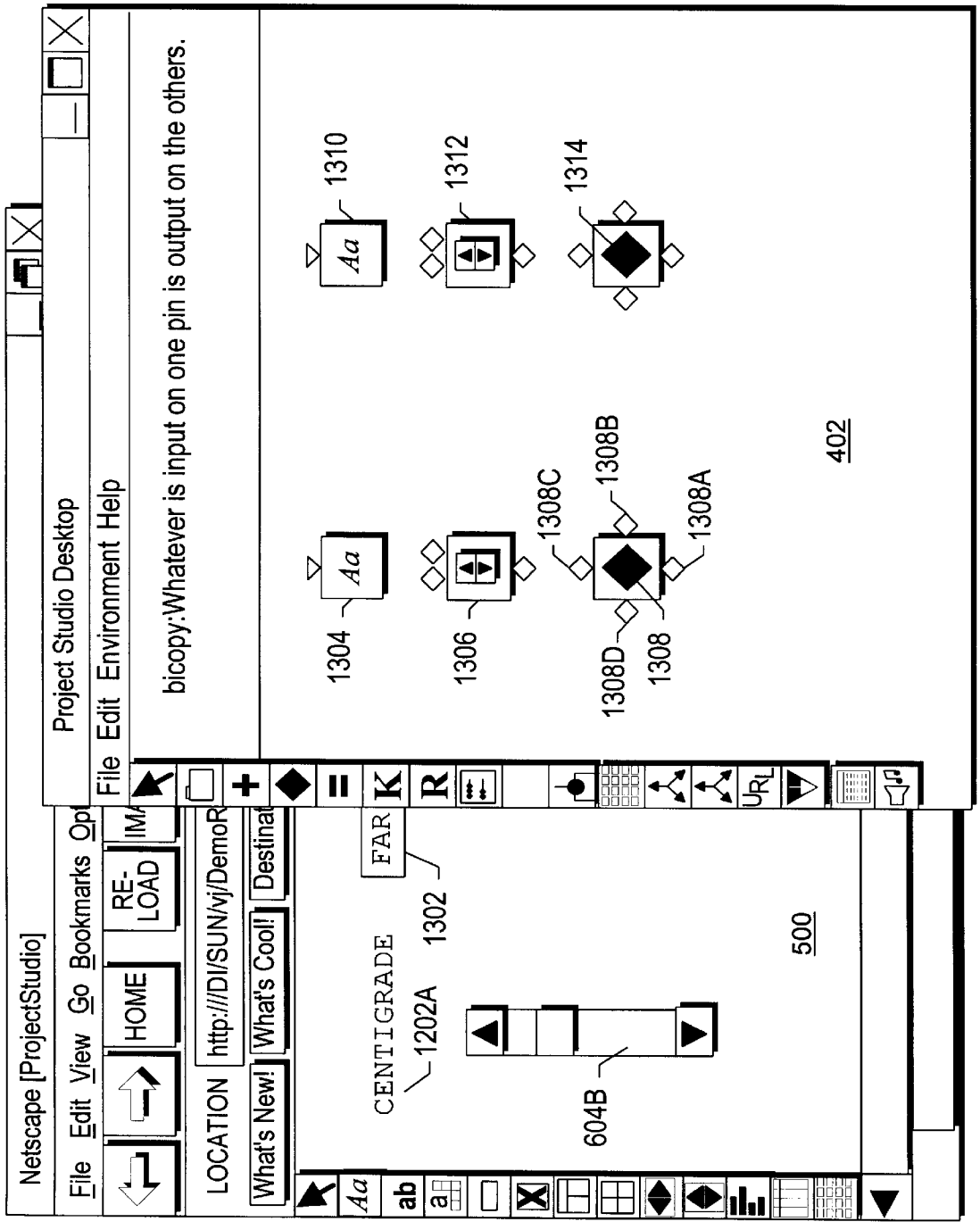

Netscape [ProjectStudio]
File Edit View Go Bookmarks Op
HOME
RE-LOAD
LOCATION
http:///DI/SUN/vj/DemoR
What's New!
What's Cool!
Destinat
Project Studio Desktop
File Edit Environment Help
bicopy:Whatever is input on one pin is output on the others.
1310
1312
1314
1304
1306
1308C
1308B
1308A
1308D
1308
402
FAR
CENTIGRADE
1302
1202A
604B
500

FIG.-13

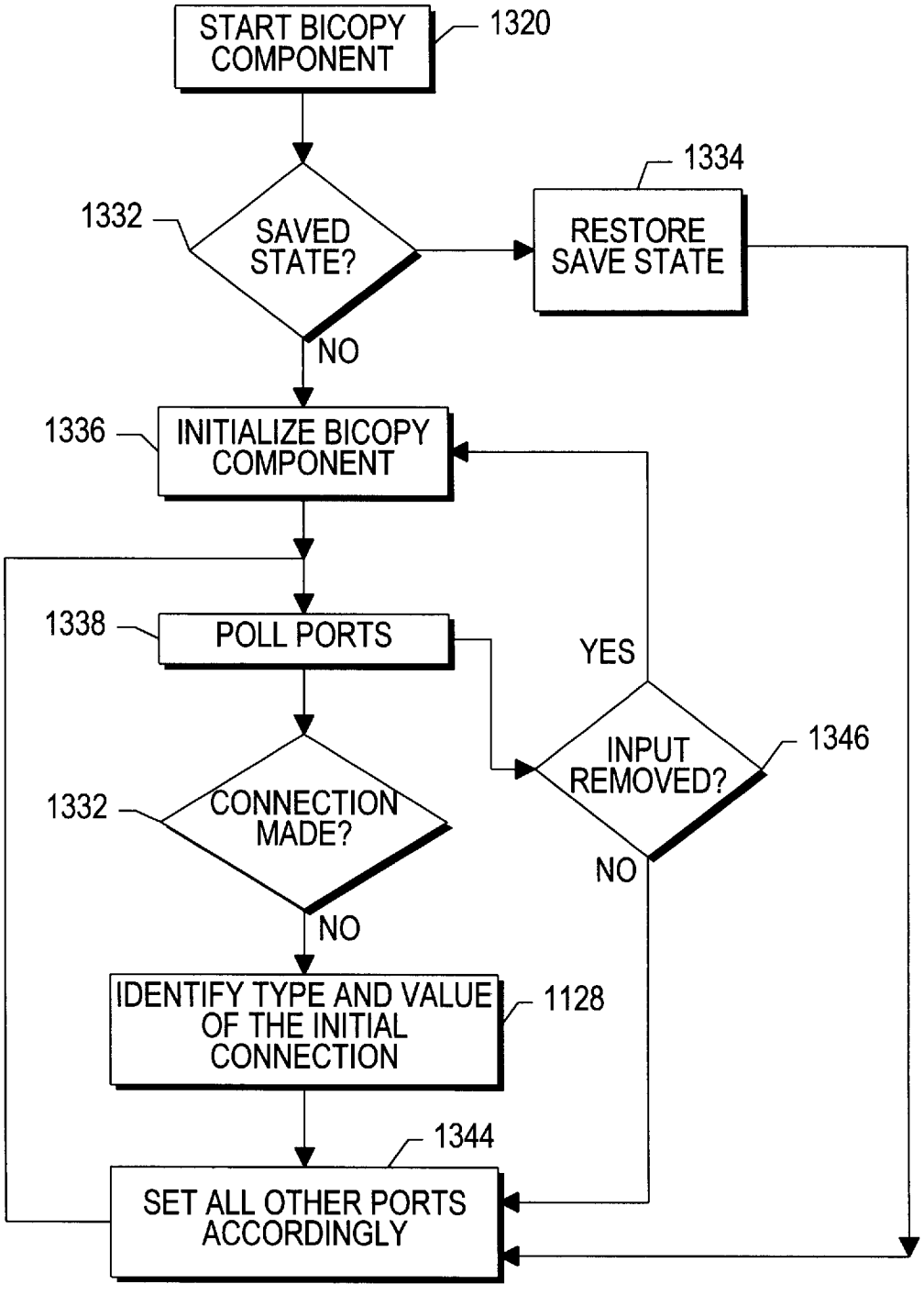

START BICOPY COMPONENT
1320
SAVED STATE?
1332
RESTORE SAVE STATE
1334
NO
INITIALIZE BICOPY COMPONENT
1336
POLL PORTS
1338
YES
INPUT REMOVED?
1346
CONNECTION MADE?
1332
NO
IDENTIFY TYPE AND VALUE OF THE INITIAL CONNECTION
1128
SET ALL OTHER PORTS ACCORDINGLY
1344

FIG.-13A

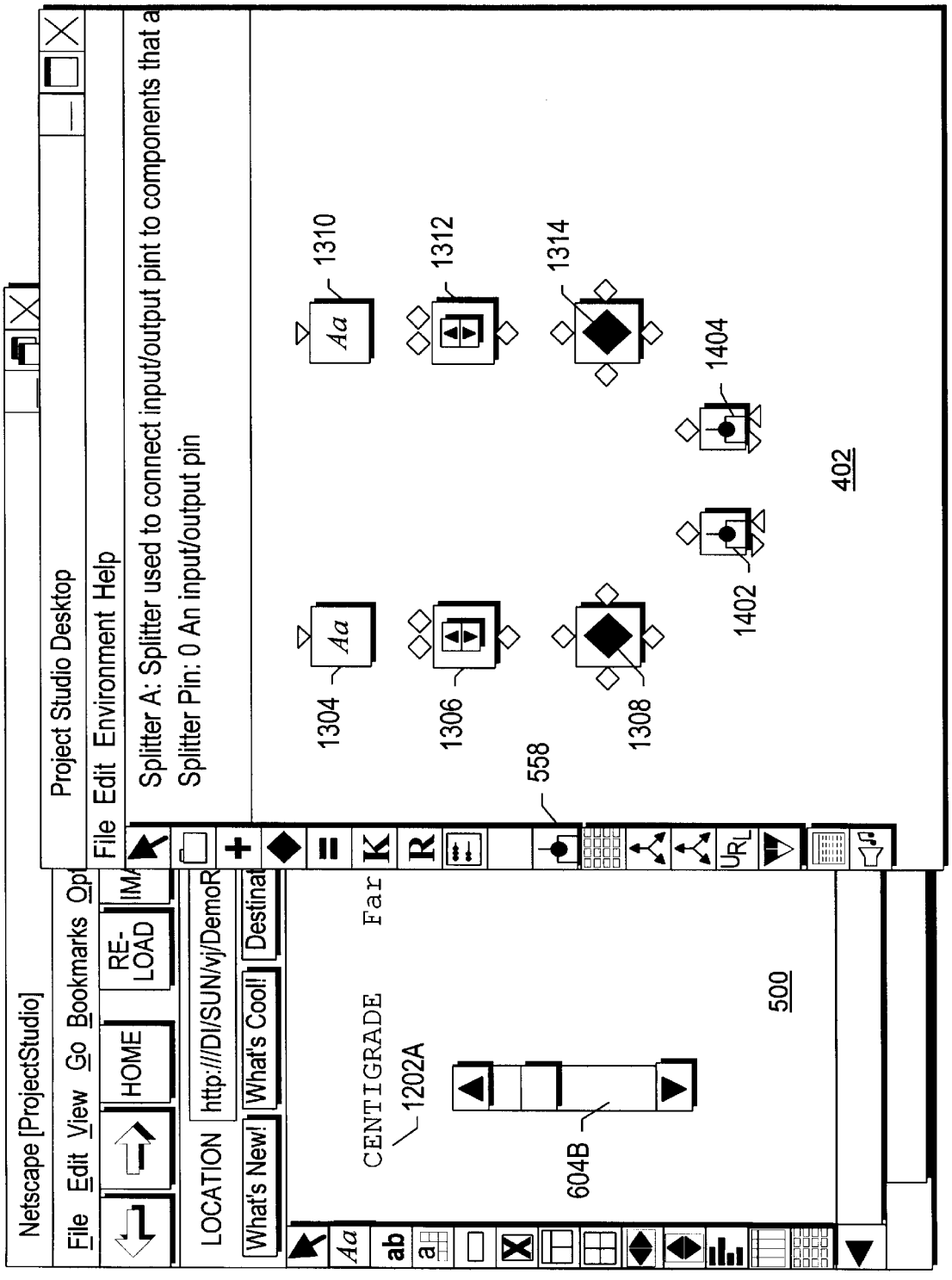

Netscape [ProjectStudio]
File Edit View Go Bookmarks Opt
HOME
RE-LOAD
LOCATION http://DI/SUN/vj/DemoR
What's New!
What's Cool!
Destinat
Project Studio Desktop
File Edit Environment Help
Splitter A: Splitter used to connect input/output pint to components that a
Splitter Pin: 0 An input/output pin
CENTIGRADE Far
1202A
604B
500
558
1304
1306
1308
1310
1312
1314
1402
1404
402

FIG.-14

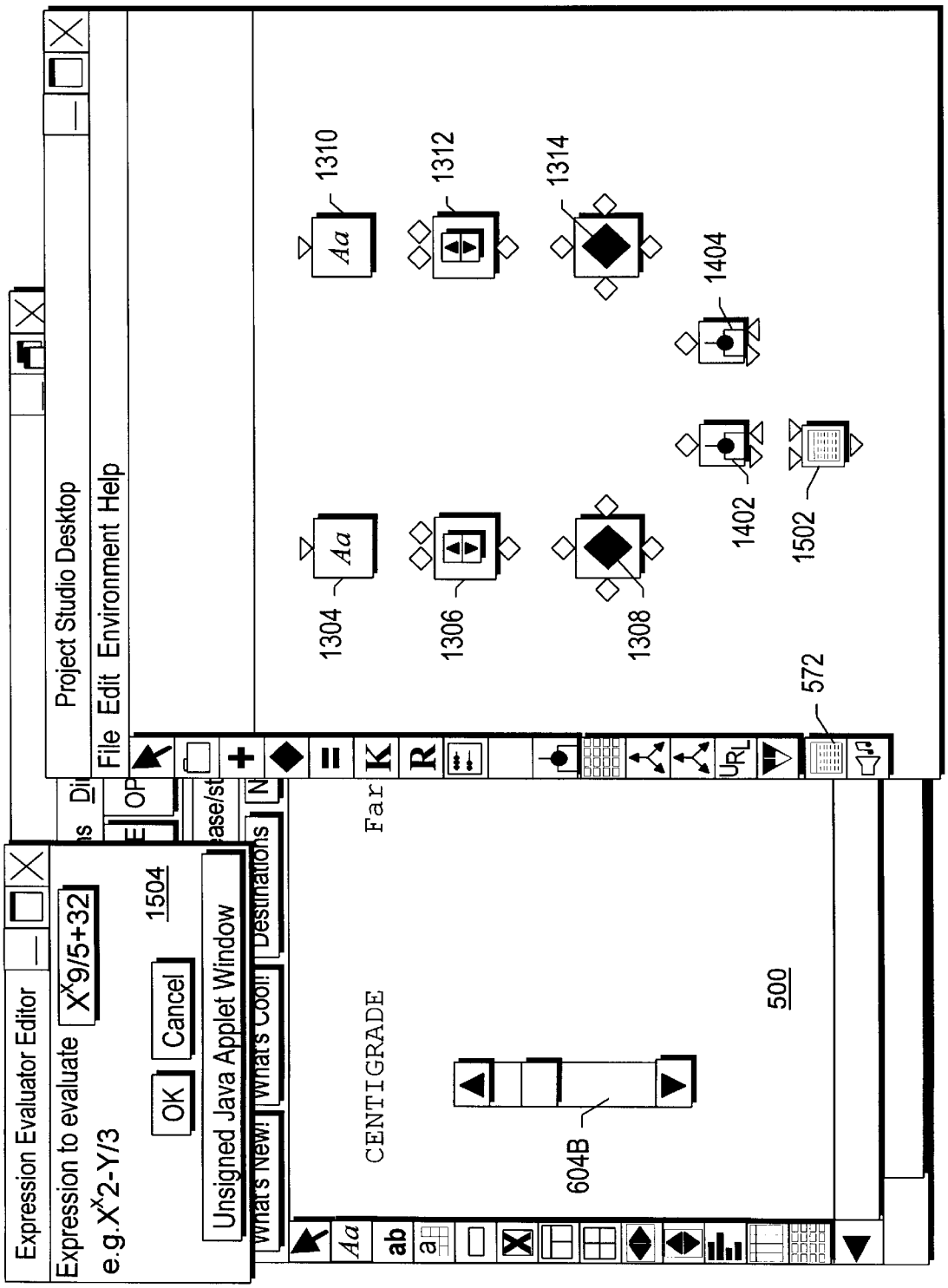

Project Studio Desktop
File Edit Environment Help
Expression Evaluator Editor
Expression to evaluate
e.g. X^2-Y/3
X^9/5+32
OK
Cancel
1504
Unsigned Java Applet Window
What's New!
What's Cool!
Destinations
CENTIGRADE
Far
500
604B
572
1304
1306
1308
1310
1312
1314
1402
1404
1502

FIG.-15

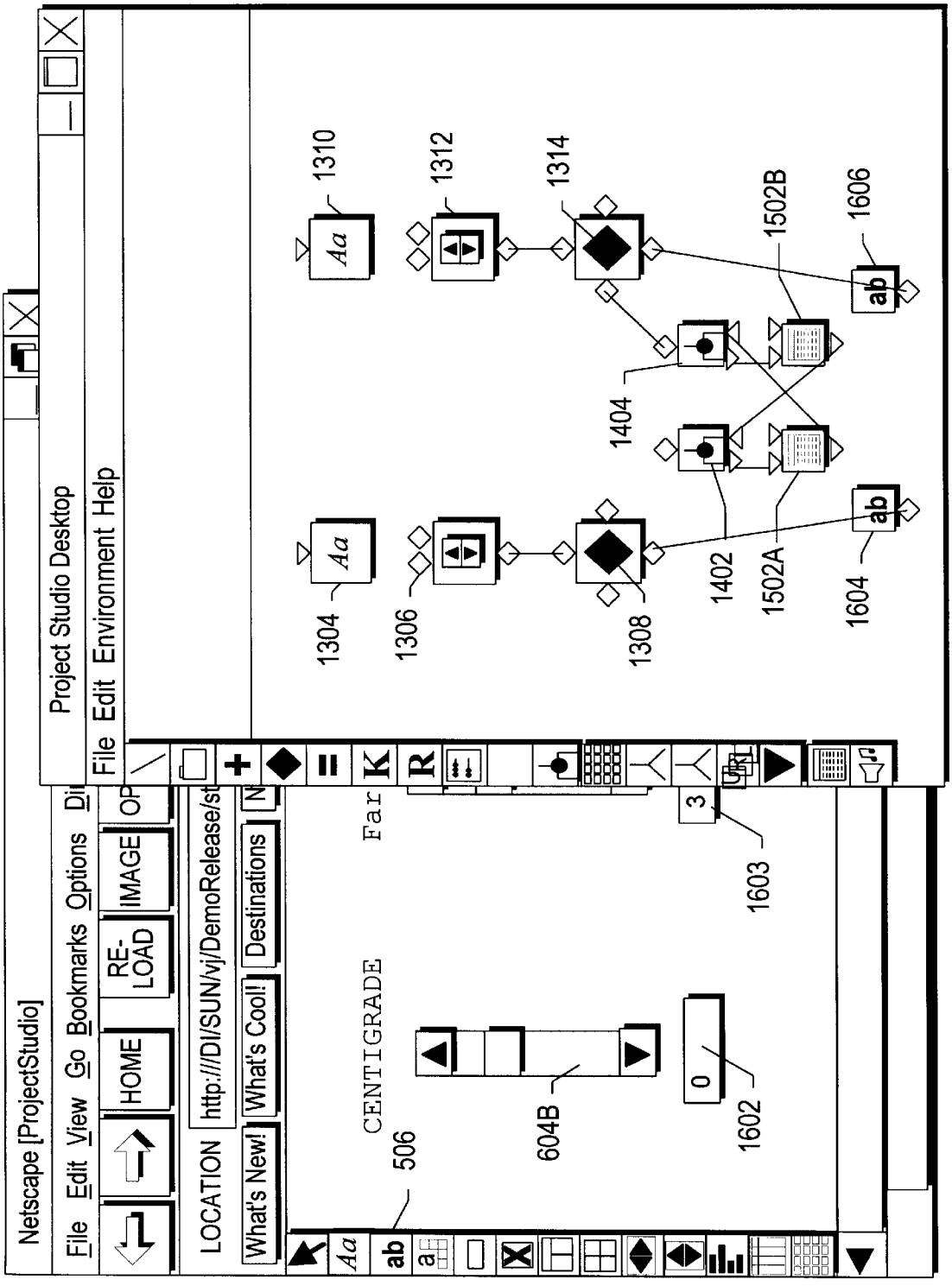

Netscape [ProjectStudio]
File Edit View Go Bookmarks Options Di
HOME
RE-LOAD
IMAGE
OP
LOCATION
http:///DI/SUN/vj/DemoRelease/st
What's New!
What's Cool!
Destinations
N
Project Studio Desktop
File Edit Environment Help
Far
CENTIGRADE
506
604B
1602
1603
1304
1306
1308
1310
1312
1314
1402
1404
1502A
1502B
1604
1606

FIG.-16

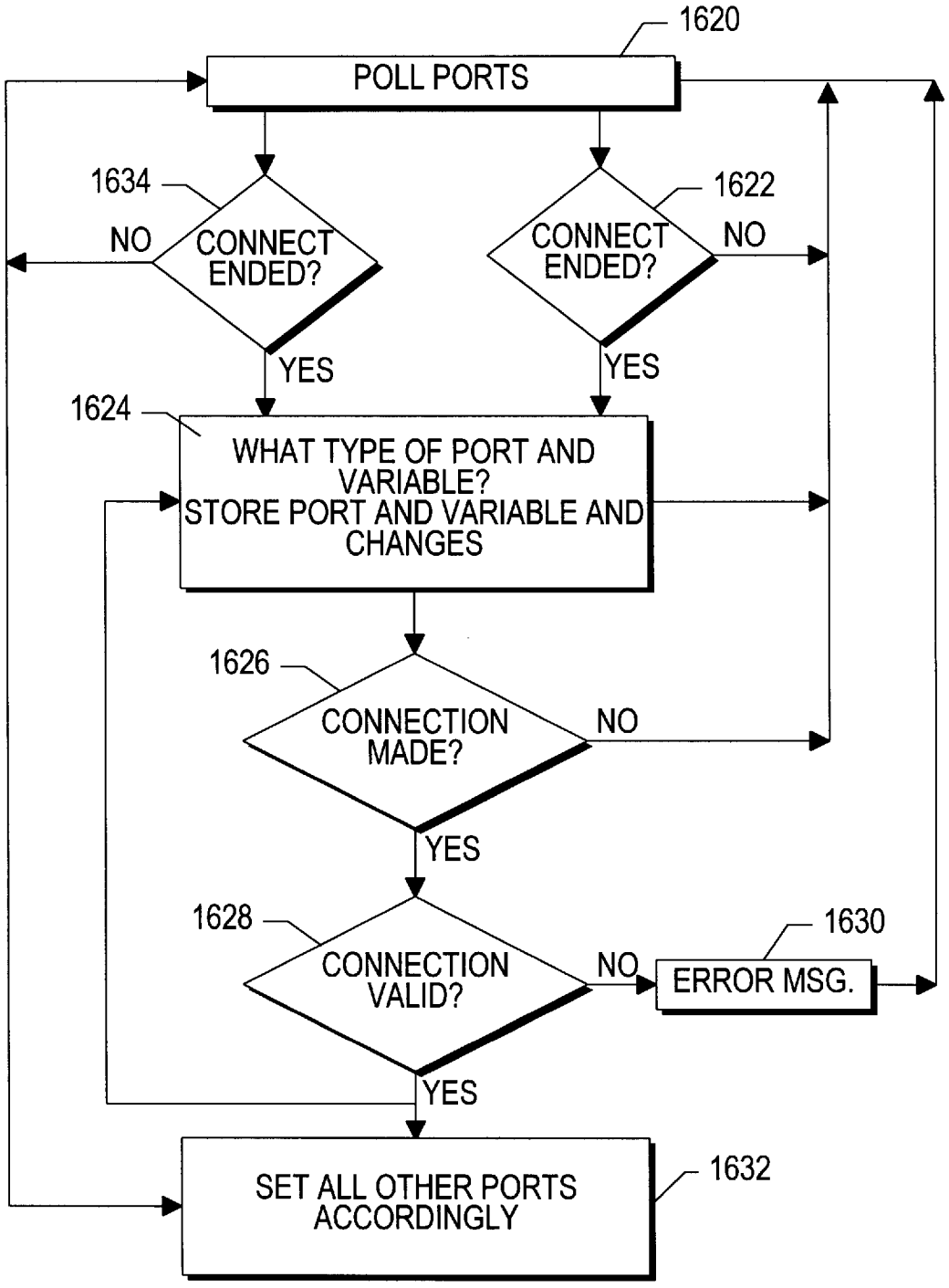

1620
POLL PORTS
1634
NO
CONNECT ENDED?
YES
1622
CONNECT ENDED?
NO
YES
1624
WHAT TYPE OF PORT AND VARIABLE?
STORE PORT AND VARIABLE AND CHANGES
1626
CONNECTION MADE?
NO
YES
1628
CONNECTION VALID?
NO
1630
ERROR MSG.
YES
SET ALL OTHER PORTS ACCORDINGLY
1632

FIG.-16A

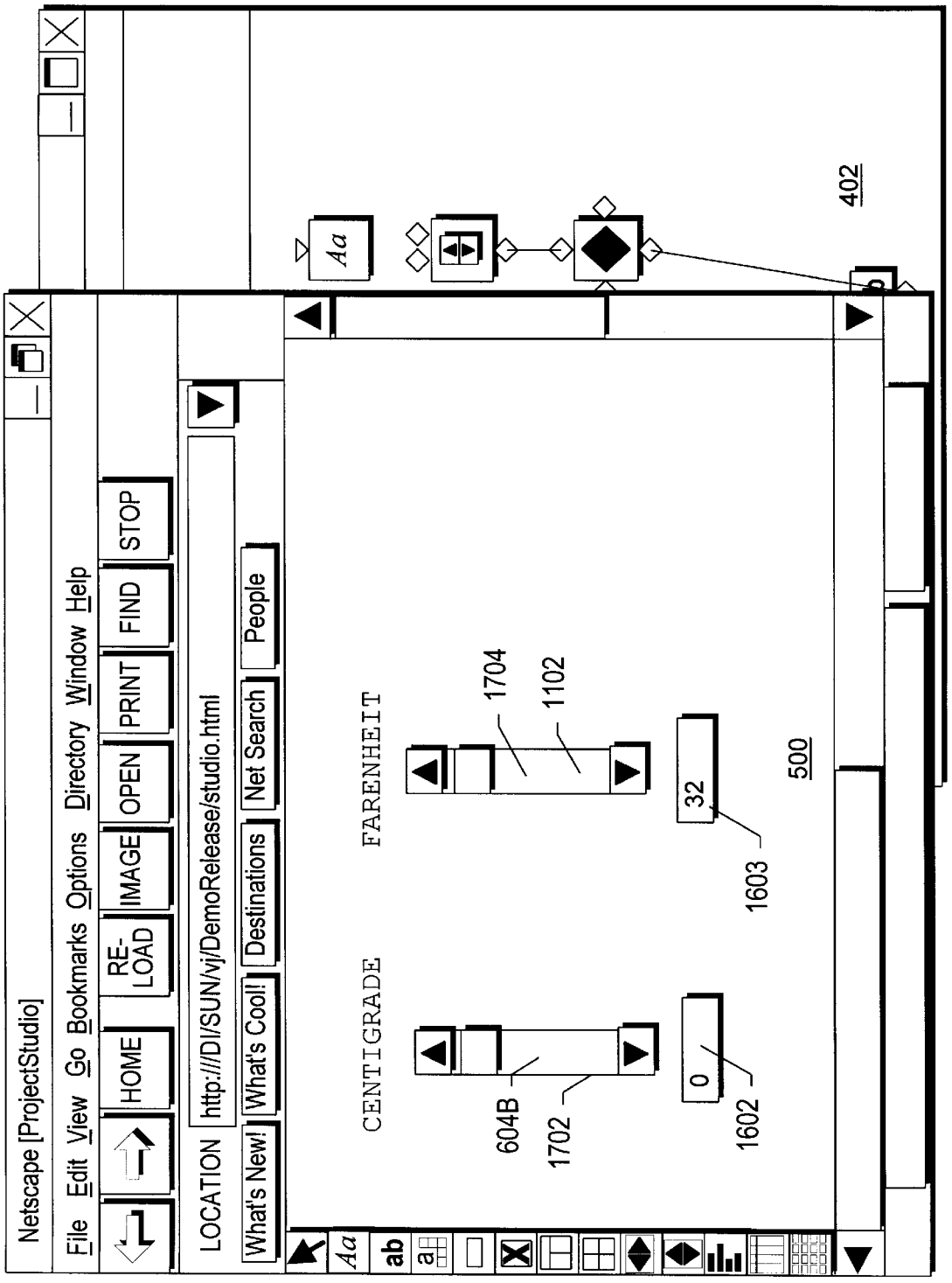

Netscape [ProjectStudio]
File Edit View Go Bookmarks Options Directory Window Help
HOME
RE-LOAD
IMAGE
OPEN
PRINT
FIND
STOP
LOCATION http:///DI/SUN/vj/DemoRelease/studio.html
What's New!
What's Cool!
Destinations
Net Search
People
Aa
402
FARENHEIT
CENTIGRADE
1704
1102
32
1603
500
604B
1702
0
1602

FIG.-17

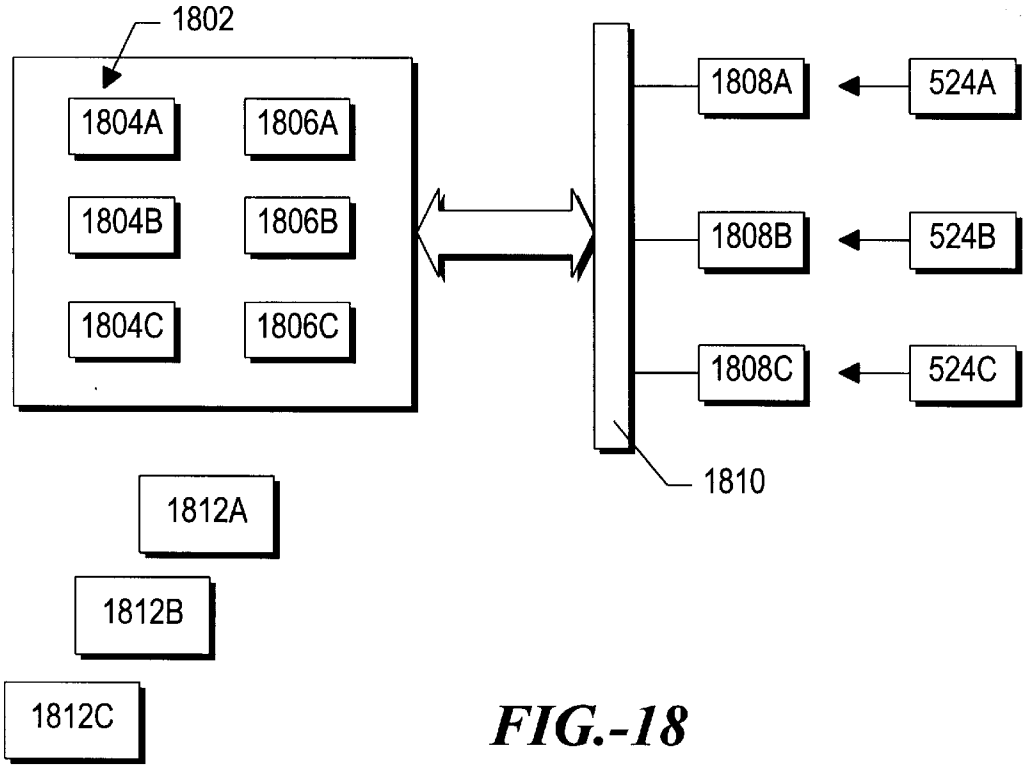


FIG.-18

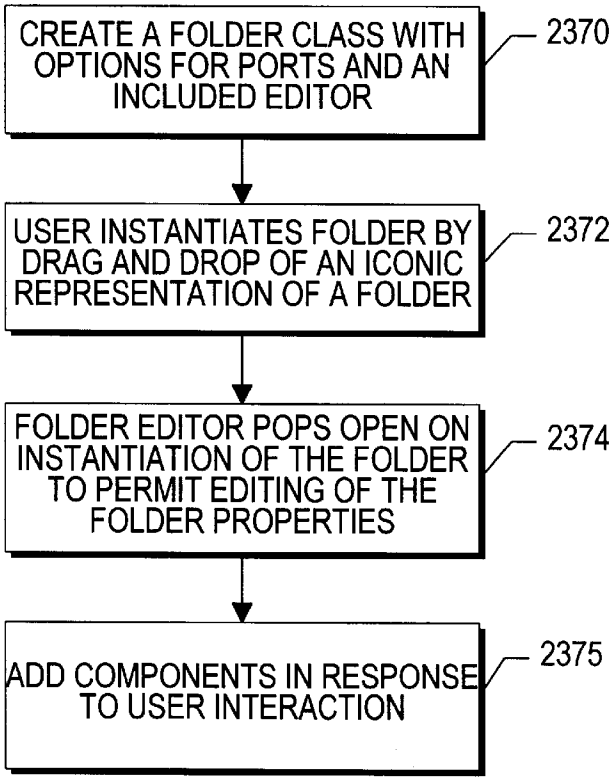


FIG.-23A

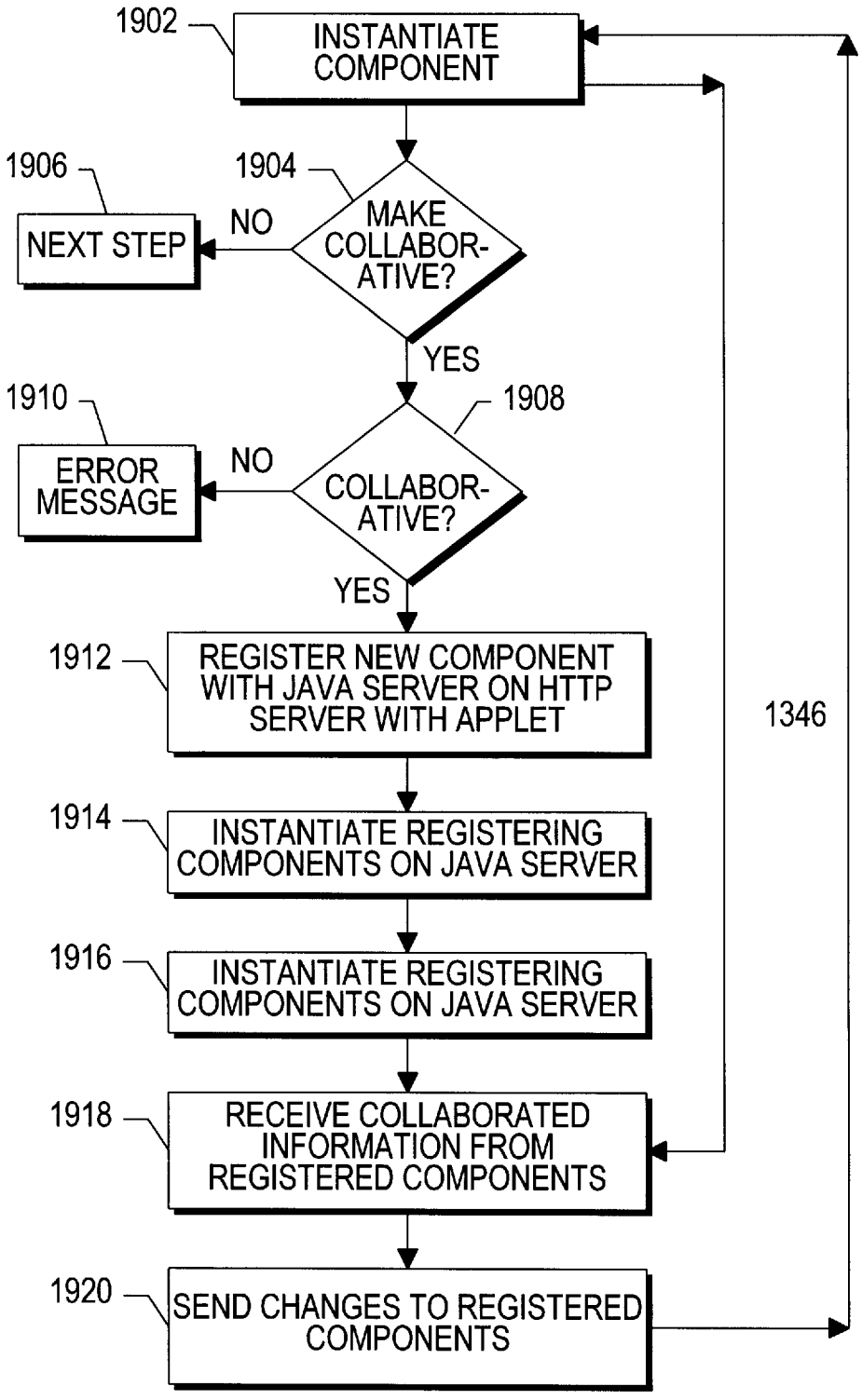

1902
INSTANTIATE COMPONENT
1904
MAKE COLLABOR-ATIVE?
1906
NEXT STEP
NO
YES
1908
COLLABOR-ATIVE?
1910
ERROR MESSAGE
NO
YES
1912
REGISTER NEW COMPONENT WITH JAVA SERVER ON HTTP SERVER WITH APPLET
1914
INSTANTIATE REGISTERING COMPONENTS ON JAVA SERVER
1916
INSTANTIATE REGISTERING COMPONENTS ON JAVA SERVER
1918
RECEIVE COLLABORATED INFORMATION FROM REGISTERED COMPONENTS
1920
SEND CHANGES TO REGISTERED COMPONENTS
1346

FIG.-19

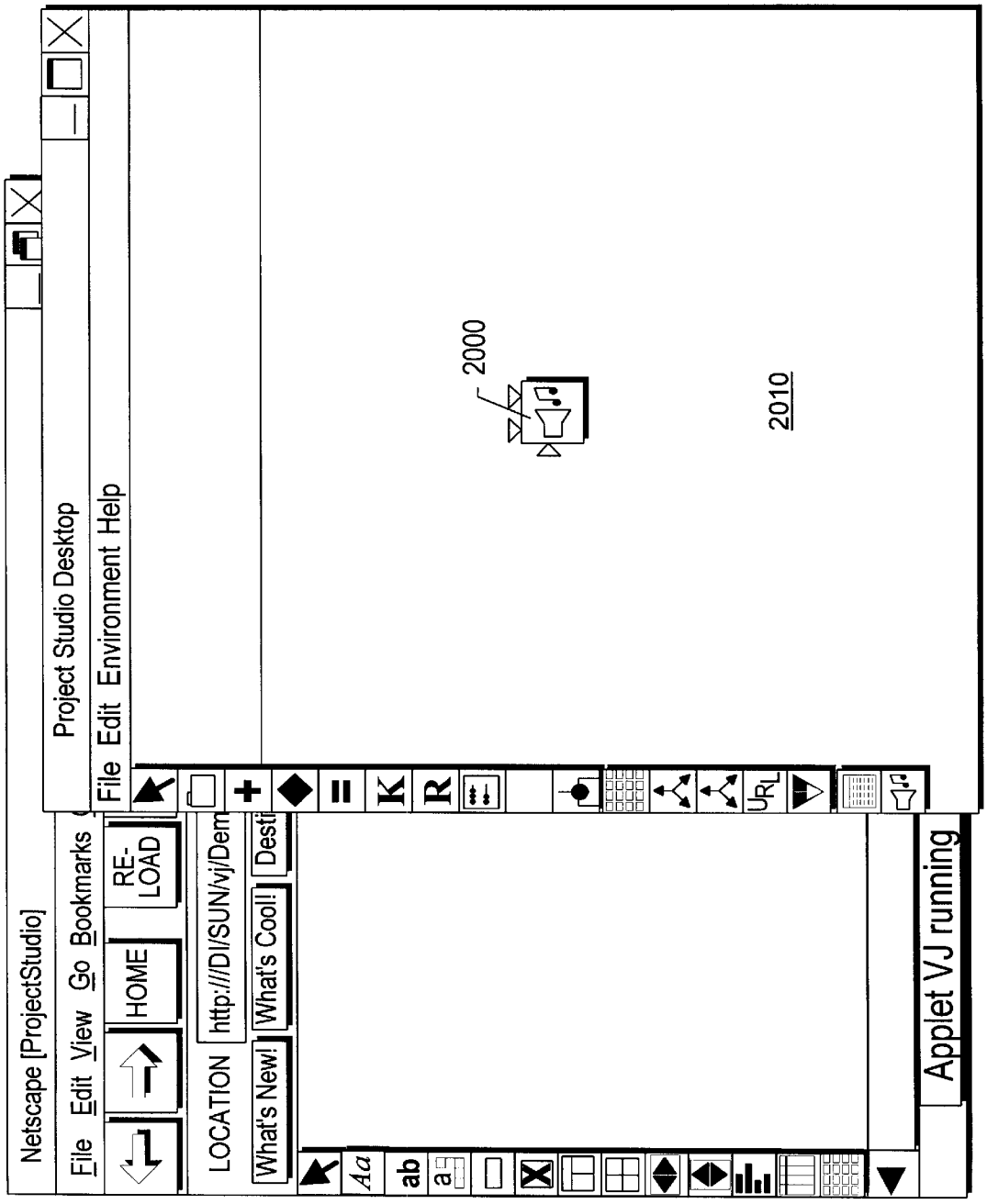

Netscape [ProjectStudio]
File Edit View Go Bookmarks
RE-LOAD
HOME
LOCATION
http:///D|/SUN/vj/Dem
What's New!
What's Cool!
Desti
Project Studio Desktop
File Edit Environment Help
2000
2010
URL
Applet VJ running

FIG.-20

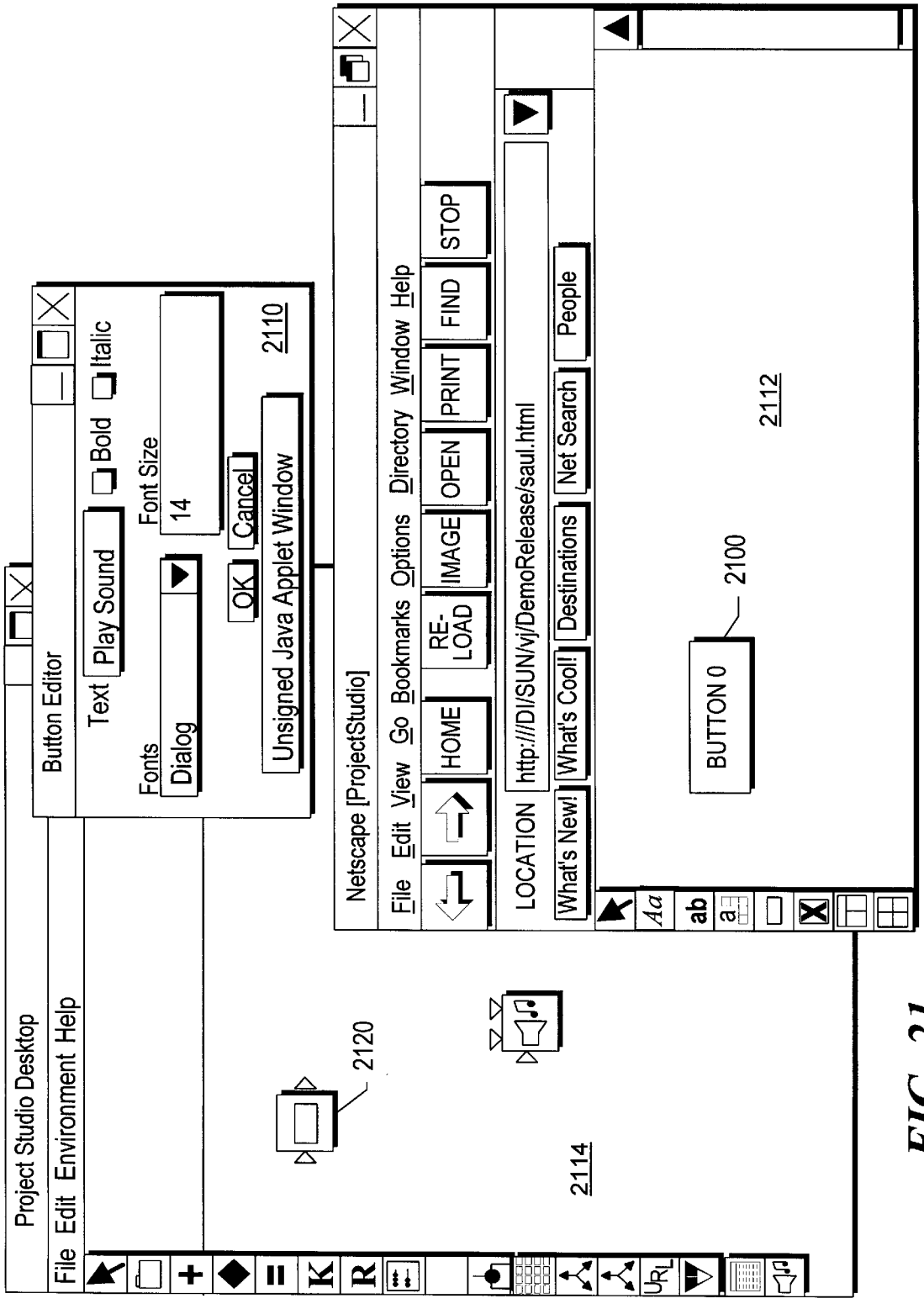

Project Studio Desktop
File Edit Environment Help
Button Editor
Text
Play Sound
Bold
Italic
Fonts
Dialog
Font Size
14
OK
Cancel
Unsigned Java Applet Window
2110
Netscape [ProjectStudio]
File Edit View Go Bookmarks Options Directory Window Help
HOME
RE-LOAD
IMAGE
OPEN
PRINT
FIND
STOP
LOCATION
http:///D|/SUN/vj/DemoRelease/saul.html
What's New!
What's Cool!
Destinations
Net Search
People
BUTTON 0
2100
2112
2120
2114

FIG.-21

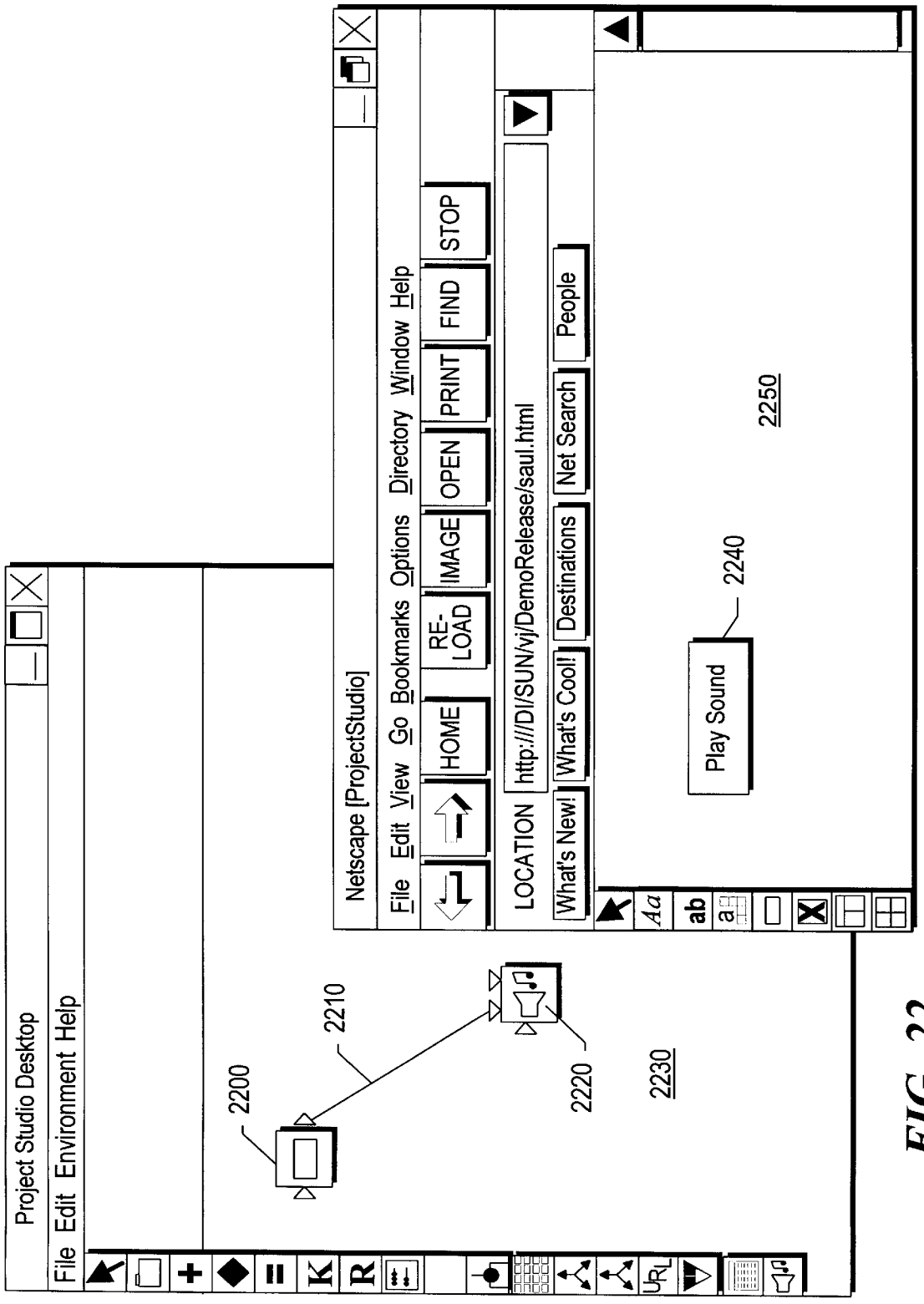

Project Studio Desktop
File Edit Environment Help
Netscape [ProjectStudio]
File Edit View Go Bookmarks Options Directory Window Help
HOME
RE-LOAD
IMAGE
OPEN
PRINT
FIND
STOP
LOCATION
http:///DI/SUN/vj/DemoRelease/saul.html
What's New!
What's Cool!
Destinations
Net Search
People
Play Sound
2200
2210
2220
2230
2240
2250

FIG.-22

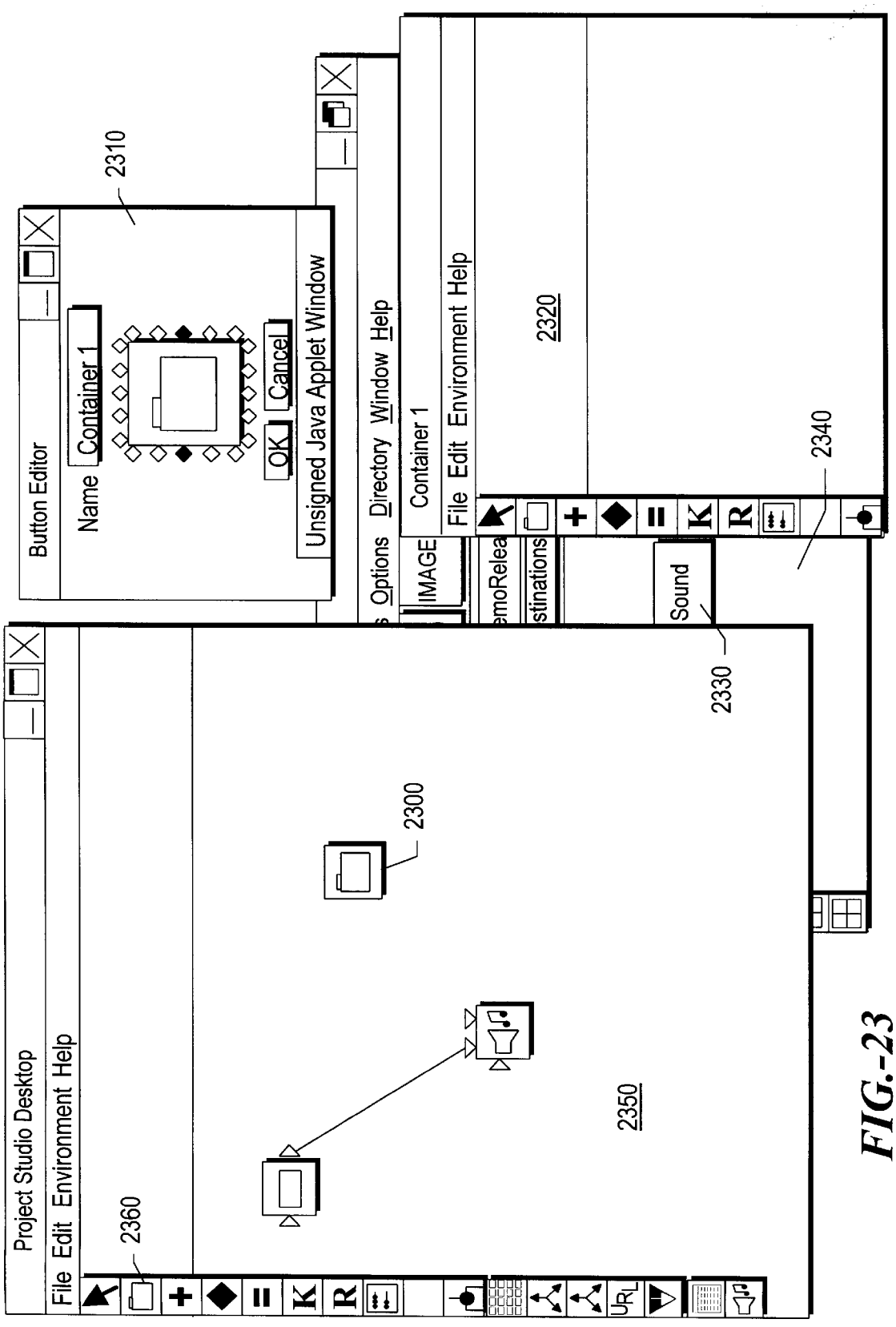

Project Studio Desktop
File Edit Environment Help
2360
2300
2350
2330
Sound
2340
2320
File Edit Environment Help
Container 1
Options Directory Window Help
Unsigned Java Applet Window
Button Editor
Name
Container 1
OK
Cancel
2310

FIG.-23

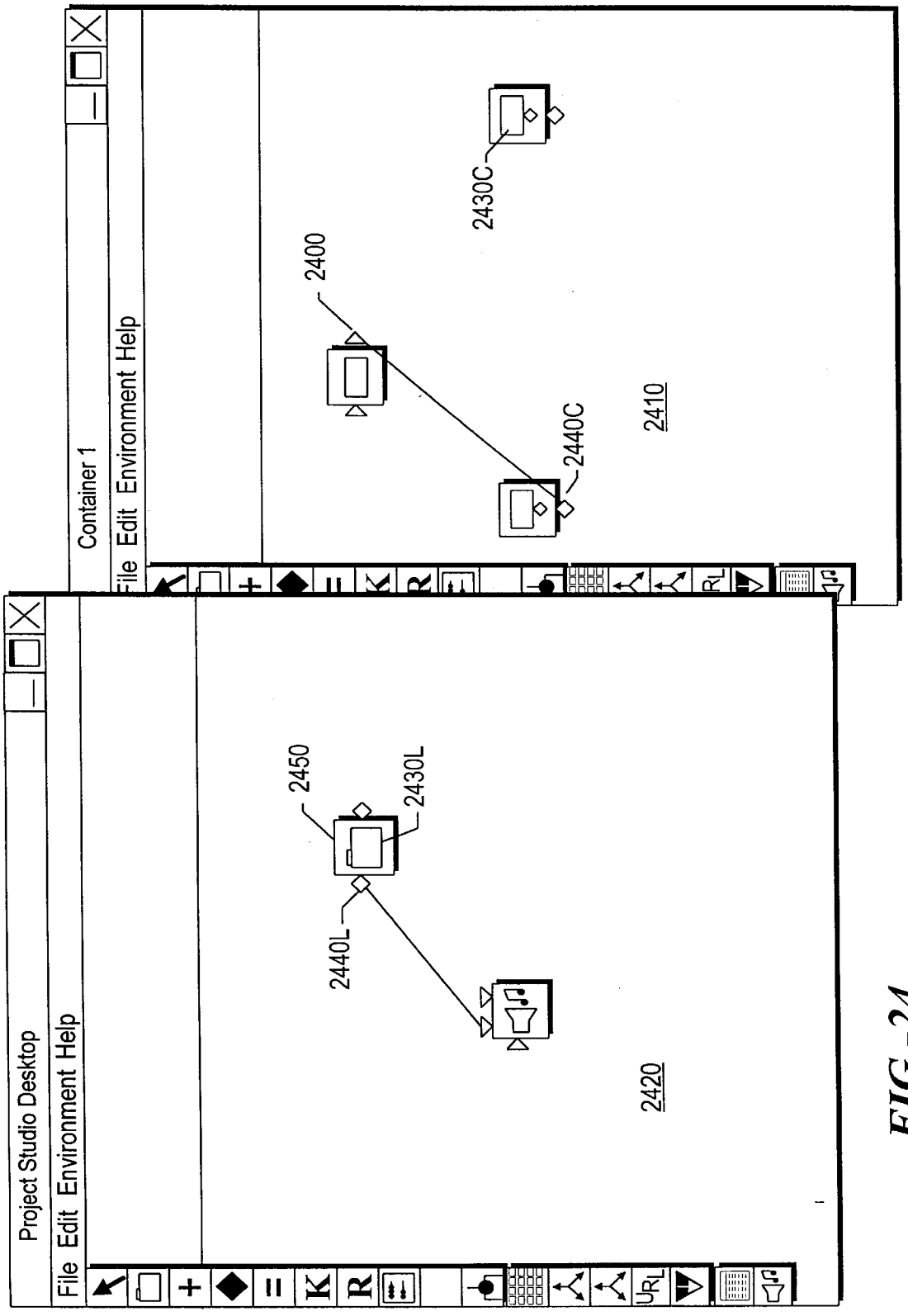

Project Studio Desktop
File Edit Environment Help
Container 1
File Edit Environment Help
2400
2410
2420
2430C
2430L
2440C
2440L
2450

FIG.-24

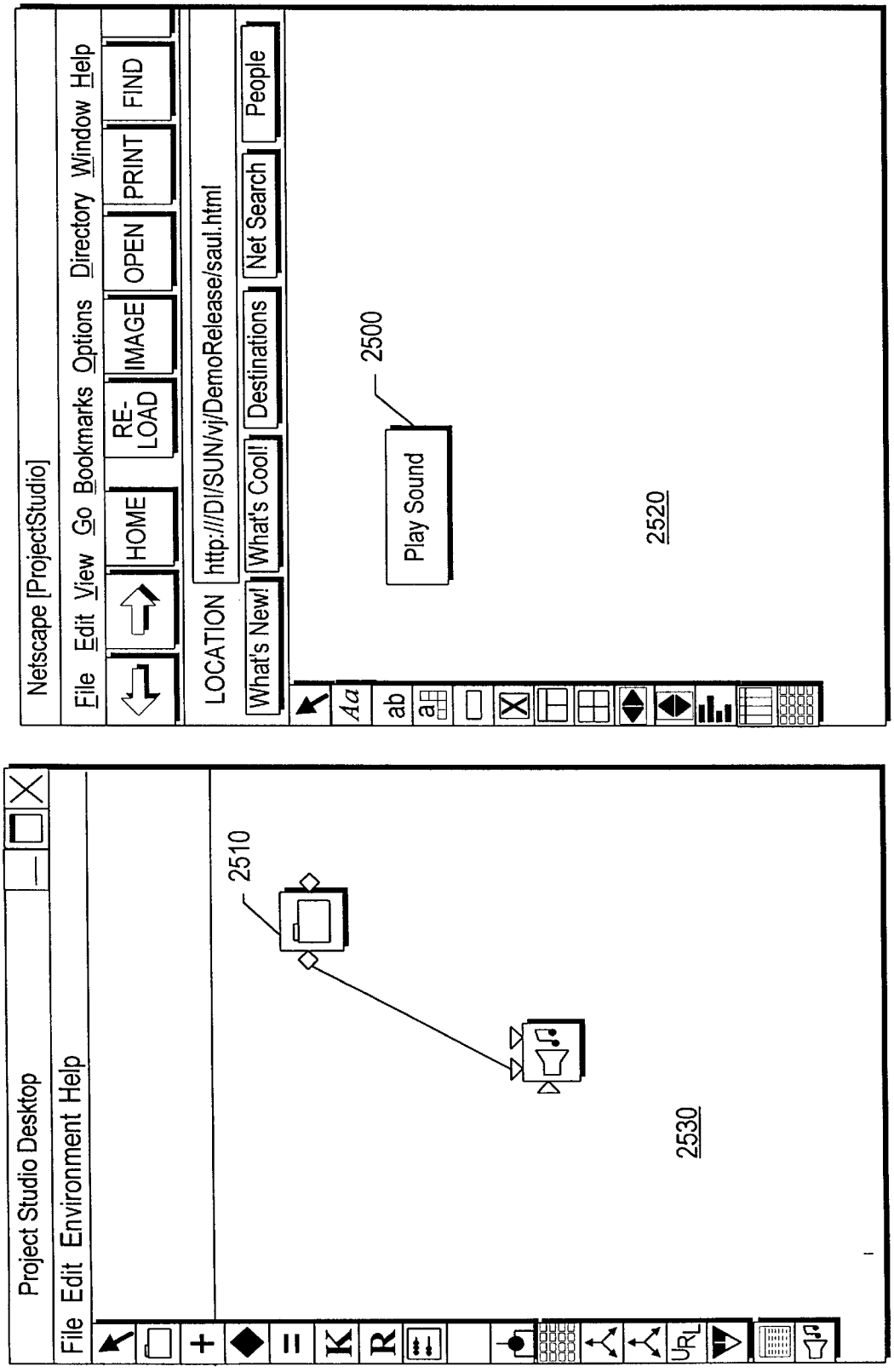

Netscape [ProjectStudio]
File Edit View Go Bookmarks Options Directory Window Help
HOME
RE-LOAD
IMAGE
OPEN
PRINT
FIND
LOCATION http:///D|/SUN/vj/DemoRelease/saul.html
What's New!
What's Cool!
Destinations
Net Search
People
2500
Play Sound
2520
Project Studio Desktop
File Edit Environment Help
2510
2530

FIG.-25

SYSTEM, METHOD AND ARTICLE OF MANUFACTURE FOR PROVIDING DYNAMIC USER EDITING OF OBJECT ORIENTED COMPONENTS USED IN AN OBJECT ORIENTED APPLET OR APPLICATION

COPYRIGHT NOTIFICATION

FIELD OF THE INVENTION

This invention generally relates to improvements in computer systems and, more particularly, to an improved system for dynamically editing predetermined components of object oriented based applications and applets.

BACKGROUND OF THE INVENTION

Object oriented based programming (OOP) is probably the most arresting, stimulating and intriguing aspect of programming in today's software world. Although it has been available for some time in languages such as Simula and SmallTalk and recently in C++ and Java, OOP has only recently taken hold as the hoped for solution to closing the gap between the theoretical capability of hardware and the general performance of software while simultaneously solving problems left over from prior software development approaches.

In the past, programming development which began with a single procedure approach, evolved to modular programming, went from there to structured programming and then branched off into computer aided software engineering (CASE) and program generators. All of these methodologies, while solving some or many of the difficulties inherent in prior approaches, introduced their own limitations and inefficiencies. Program bloat, data corruption and "spaghetti" code were but a few of the problems that were caused or left unsolved by the aforementioned software development approaches.

In the early days of procedural programming, the programmer called libraries provided by the operating system to perform certain tasks, but basically the program executed down the page from start to finish, and the programmer was solely responsible for the flow of control. This was appropriate for printing out paychecks, calculating a mathematical table, or solving other problems with a program that executed in just one way.

The development of graphical user interfaces began to turn this procedural programming arrangement inside out. These interfaces allow the user, rather than program logic, to drive the program and decide when certain actions should be performed. Today, most personal computer software accomplishes this by means of an event loop which monitors the mouse, keyboard, and other sources of external events and calls the appropriate parts of the programmer's code according to actions that the user performs. The programmer no longer determines the order in which events occur. Instead, a program is divided into separate pieces that are called at unpredictable times and in an unpredictable order. By relinquishing control in this way to users, the developer creates

a program that is much easier to use. Nevertheless, individual pieces of the program written by the developer still call libraries provided by the operating system to accomplish certain tasks, and the programmer must still determine the flow of control within each piece after it's called by the event loop. Application code still "sits on top of" the system.

Even event loop programs require programmers to write a lot of code that should not need to be written separately for every application. The concept of an application framework carries the event loop concept further. Instead of dealing with all the nuts and bolts of constructing basic menus, windows, and dialog boxes and then making these things all work together, programmers using application frameworks start with working application code and basic user interface elements in place. Subsequently, they build from there by replacing some of the generic capabilities of the framework with the specific capabilities of the intended application.

Into to this breach, entered Object-Oriented Programming (OOP) techniques which involve the definition, creation, use and destruction of "objects." Objects are self-sufficient software entities comprising data elements and routines, or functions, sometimes called methods, which are used to manipulate the data elements. The object's data and related functions are treated by the software as an entity and they can be created, used and deleted as if they were a unitary item. Together, the data and functions enable objects to model virtually any real-world entity in terms of its characteristics, which can be represented by the data elements, and its behavior, which can be represented by its data manipulation functions. In this way, objects can model concrete things like people and computers, and they can also model abstract concepts like numbers or geometrical designs.

Objects are defined by creating "classes" which are not per se objects themselves, but which act as templates that instruct a compiler how to construct an actual object. A class may, for example, specify the number and type of data variables and the steps involved in the functions which manipulate the data. An object is actually created in the program by means of a special function called a constructor which uses the corresponding class definition and additional information, such as arguments provided during object creation, to construct and initialize the object and its data members. Likewise objects are destroyed by a special function called a destructor. Objects are employed by using their data and invoking their functions to accomplish a task.

The concept of an object is predicated on and the benefits of object-oriented programming techniques arise from the use of three basic principles; those of encapsulation, polymorphism and inheritance. These principles work in conjunction with objects as described below. It is noteworthy to distinguish between an object and a class of objects. A class is a type definition or template used to create objects in programs. The objects so created are then merely each a single instance of the class of objects, which is often just called a class. A class has no memory or behavior of its own except to serve as the blueprint from which objects can be created.

An object is a self-sufficient component that includes both data and function. An object is of the same type as the class from which it has been derived. Objects are said to be instantations of their class and use memory for their data and functions, unlike the class template itself which does not.

Objects can be designed to hide, or encapsulate, all, or a portion of, their internal data structure and internal functions. OOP also allows a programmer to create an object that

is a part of another object and thereby define assemblies and sub-assemblies, as may be required by a program or the situation or item it is modeling.

More particularly, during program design, a program developer can define objects in which all or some of the data variables and all or some of the related functions are considered "private" or made available for use only by the object itself. Other data or functions can be declared "public" or available for use by other objects or programs.

Further, access to private variables by other objects or programs can be controlled by defining public functions for an object which access the object's private data. The public functions form a controlled and consistent interface between the private data and the "outside" world. Any attempt to write program code which directly accesses the private variables causes the compiler to generate an error during program compilation which error stops the compilation process and prevents the program from being run.

Polymorphism is capability to conceal the different implementations behind a common interface. This means that separate objects of the same class can have different internal functions and data and implement received messages differently, but still produce uniform or consistent results. For example, an addition function may be defined as variable A plus variable B (A+B) and this same format can be used whether variables A and B represent numbers, characters or monetary units such as dollars and cents. However, the actual program code which performs the addition may differ widely depending on the type of variables that comprise A and B. Polymorphism allows three separate objects that employ different function definitions to be written, one for each type of variable (numbers, characters and dollars). After the functions have been defined, a program can later refer to the addition function by its common format (A+B) and, during compilation, the OOP based compiler will determine which of the three functions needs to be used by examining the variable types. The compiler will then substitute the proper function code in the object it compiles. Polymorphism allows similar functions that produce analogous results to be "grouped" in the program source code to produce a more logical and clearer program flow.

The third principle which underlies object-oriented programming is that of inheritance. Inheritance allows program developers to easily reuse pre-existing programs or portions thereof to avoid creating software from scratch. The principle of inheritance allows a software developer to declare classes (and the objects which are later created from them) as related. Specifically, classes may be designated as subclasses of base classes. A subclass "inherits" and has access to all of the public functions of its base classes just as if these functions appeared in the subclass. Alternatively, a subclass can override some or all of its inherited functions merely by defining a new function with the same form (overriding or modification does not alter the function in the base class, but merely modifies the use of the function in the subclass). The creation of a new subclass which has some of the functionality (with selective modification) of another class allows software developers to easily customize existing code to meet their particular needs while still taking advantage of reusing prior, usually debugged and well behaved code, rather than having to write and qualify new code of their own.

By utilizing the concepts of encapsulation, inheritance and polymorphism, an object can be made to accurately and independently represent just about anything in our world, real or simulated. In fact, the limits of our logical perceptions of such representation is the only restraint on the kinds of things that can become objects in object-oriented software. Some typical categories are as follows:

- Objects can represent physical objects, such as airplanes in an air traffic control system, components in a stereo or television system, balance sheet and income statement elements in a fundamental analysis company business model, or stars in the simulated night sky on display at a planetarium;
- Objects can represent elements of the computer-user environment such as windows, scrollbars, sliders, menus or other graphical items;
- An object can represent a collection of data, such as a personnel file or a table of the latitudes and longitudes of cities; or
- An object can represent user-defined data types such as time, angles, and complex numbers, functions or points on the plane.

While object-oriented programming offers significant improvements over other programming concepts in the design and development of programs, program development and program development tools, even within an OOP environment, still require significant outlays of time and effort. This is particularly true where the developer has to write a significant amount of code from scratch and is unable to take full advantage of the benefits of object oriented programming. The ability of development tools to negate or reduce the need to write code in the traditional sense and permit a developer to concentrate on development and visually interact with an enriched development tool is the focus and goal of the present invention.

It is usually the case that proponents of a particular type of programming language or of a specific language of that type are best able to advance their cause and the popularity and vitality of the language type or specific implementation or dialect of the language they support.

This is usually done by directly or indirectly providing appropriate tools that make use of the language type or a specific implementation of the language easy, practical and efficient. Visual Basic and Visual C++ are examples of two current programming environments with an object oriented foundation that have been developed and made available for programmers to use in creating applications for the Windows 3.x, Windows 95 and Windows NT platforms. While Visual Basic and Visual C++ undoubtedly make program development easier by including tools, called Wizards, that relieve the programmer of the necessity to write the underlying Basic or C++ code needed to create and implement such typical graphical user interface (GUI) elements as scrollbars, sliders, buttons or dialog boxes and to define their properties, these tools do not go far enough in easing the programmer's development burden. For example, it is still necessary in either Visual Basic and Visual C++ for the programmer to write code that defines and controls the interrelationship of the elements selected for use in the program under development or to otherwise manually intercede in the object based "point and click" or "drag and drop" aspects of this program development process.

This is true in the development of general OOP based applications and also in development environments for creating Applets in a JAVA system. As the Java system and applet creation becomes more widely used, the need to simplify the development of these applications becomes desirable. In addition, while the developer in these prior art visual programming environments is given a Wizard that writes the underlying code to make an event involving one or more of the selected elements occur, the ability to simultaneously view and experience that interrelationship is not provided.

It would be desirable to have the applets designed with such a tool, or the tool's objects, components or assemblies of objects and components or portions thereof, so that when a component is initially instantiated, a customization/editwindow would dynamically appear to allow a user to tailor the particular component.

SUMMARY OF THE INVENTION

The present invention to provides a programming environment and appropriate tools therefor that are richer in visual function and ease of use than presently available visual programming environments, including capability for dynamic editing of component objects.

The present invention additionally provides such dynamic editing capability as soon as the component is instantiated or a component editing request is made.

The present invention is also able to edit each component's properties and their limits as desired and then observe the edited changes as soon as the window editor is closed, and finally the invention achieves such dynamic editing capability in an effective, non-intrusive manner.

The above objectives are achieved by defining an editor window in predetermined class templates as a method corresponding to the editor. Then, when a component is instantiated from one of said predetermined classes, the editor is automatically opened to permit the user to make changes in the component's properties. When editing is completed, the editor window is closed, the changes are accepted and then displayed for the edited component. Components are thereafter monitored for a user re-editing request which, when detected, causes the editing cycle to be initiated.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and further advantages of the invention may be better understood by referring to the following description in conjunction with the accompanying drawings, in which:

FIG. **1** is a block schematic diagram of a typical computer system, for example, a personal computer system on which inventive object oriented based programming tools or development environment functions can operate in accordance with the present invention;

FIG. **2** depicts a block diagram of a Java platform development tool in accordance with a preferred embodiment;

FIG. **3** illustrates a block diagram showing the initialization process for the Visual Java Tool applet in accordance with a preferred embodiment;

FIG. **4**A shows an example of an illustrative World Wide Web home page as loaded by a Java enabled browser in accordance with a preferred embodiment;

FIG. **4**B illustrates the same web page with its main pull-down menu activated in accordance with a preferred embodiment;

FIG. **4**C depicts the "Open File" pull-down menu of the home page shown in FIG. **4**B in accordance with a preferred embodiment;

FIG. **4**D shows the VJ Tool applet after it has been initialized and is ready to run in accordance with a preferred embodiment;

FIG. **5** illustrates the physical or end user view screen portion in accordance with a preferred embodiment;

FIG. **6** shows the creation of a scrollbar which will be used to indicate Centigrade temperatures in an example of how the present invention can be utilized in accordance with a preferred embodiment;

FIG. **6**A depicts a flow chart describing the socialization of new components in accordance with a preferred embodiment.

FIG. **7** visually describes an example of marqueing or sizing of a vertical scrollbar in accordance with a preferred embodiment;

FIG. **8** depicts another example of marqueing or adjusting the size of a vertical scrollbar to a shorter, slightly wider, outline in accordance with a preferred embodiment;

FIG. **9** illustrates an example of a scrollbar object matching the same object in FIG. **8**, but created in the logical view in accordance with a preferred embodiment;

FIG. **10** shows the two pin value setting and getting capability of the scrollbar of FIG. **8** in accordance with a preferred embodiment;

FIG. **11** illustrates the addition of a second vertical scrollbar that will be set to track the range of the Fahrenheit temperature scale in accordance with a preferred embodiment;

FIG. **11**A is a flowchart of the detailed logic of the editor component in accordance with a preferred embodiment'

FIG. **12** depicts how label text is added to the scrollbars of FIG. **11** to label the scrollbar in accordance with a preferred embodiment;

FIG. **13** shows how text from a label editor has been placed as a label above the first scrollbar of FIG. **11** in accordance with a preferred embodiment;

FIG. **13**A illustrates a flowchart for the process by which the bicopy component shown in FIG. **13** functions in accordance with a preferred embodiment;

FIG. **14** illustrates the addition and use of splitters in the logical view in accordance with in accordance with a preferred embodiment;

FIG. **15** shows the addition of a calculator object to the logical view in accordance with a preferred embodiment;

FIG. **16** depicts an additional calculator and the interconnections of several objects to achieve the appropriate Centigrade/Fahrenheit relationship between scrollbars of FIG. **11** in accordance with a preferred embodiment;

FIG. **16**A is a flowchart of the detailed logic for port connection in accordance with a preferred embodiment;

FIG. **17** shows the final result of the connected scrollbars with correct Fahrenheit and Centigrade temperatures shown in the text fields in accordance with a preferred embodiment;

FIG. **18** is a diagram in block format of an arrangement adapted to provide collaboration between components or portions of components of an applet as designated by the user in accordance with a preferred embodiment;

FIG. **19** presents a flowchart of the collaboration process in accordance with a preferred embodiment;

FIG. **20** illustrates a screen with the logical view in accordance with a preferred embodiment;

FIG. **21** illustrates a screen with the logical and physical view preparing a hierarchical component in accordance with a preferred embodiment;

FIG. **22** illustrates a screen with a connection made for playing a sound in accordance with a preferred embodiment;

FIGS. **23** and **23**A illustrate an edit screen for a folder component utilized to prepare a hierarchical component and a corresponding flow chart in accordance with a preferred embodiment;

FIG. **24** illustrates a hierarchical component creation customization in accordance with a preferred embodiment; and

FIG. **25** illustrates the completed physical view of a hierarchical component in accordance with a preferred embodiment.

DETAILED DESCRIPTION

The invention is preferably practiced in the context of a suitable operating system resident on a workstation or desktop computer, such as a SUN, IBM, PS/2, or Apple, Macintosh, computer. A representative hardware environment is depicted in FIG. **1**, which illustrates a typical configuration for a computer system **100** that can be utilized to practice the subject invention. The computer **100** is controlled by a central processing unit **102** (which may be a conventional microprocessor). A number of other units, all interconnected via a system bus **108**, are provided to accomplish specific tasks. Although a particular computer may only have some of the units illustrated in FIG. **1**, or may have additional components not shown, most computers will include at least the units shown.

Specifically, computer system **100** shown in FIG. **1** includes a random access memory (RAM) **106** for temporary storage of information, a read only memory (ROM) **104** for permanent storage of the computer's configuration and basic operating commands and an input/output (I/O) adapter **110** for connecting peripheral devices such as a disk drive unit **113** and printer **114** to the bus **108**, via cables **112** and **115**, respectively. A user interface adapter **116** is also provided for connecting input devices, such as a keyboard **120**, and other known interface devices including a microphone **124**, a mouse **126** and a speaker **128**, to the bus **108**. Visual output is provided by a display device **122**, such as a video monitor, which is connected via display adapter **118** to bus **108**. Lastly, a communications adapter **134**, connected to bus **108**, provides access to a network **136**.

The computer **100** has resident thereon and its basic operations are controlled and coordinated by operating system software such as the SUN Solaris, Windows/95, Windows NT or the Java OS operating system. For purposes of the preferred embodiment as described herein, regardless of the operating system being used, computer **100** is provided, at the very least, with the Java run time environment and an optional Just-In-Time (JIT) Java compiler.

In a preferred embodiment, the invention is implemented in the Java programming language, relying substantially on its object-oriented programming techniques. Java is a compiled language, that is, Java based programs are typically written in a human-readable script which script is eventually provided as input to another program called a compiler. The compiler generates a byte code version of the script that can be loaded into, and directly executed by, any computer which contains a Java virtual machine. Java objects are compiled to class files that include bytecodes representative of the original source code program with references to methods and instance variables of the Java objects. The bytecodes are not specific to particular machines or operating systems and don't have to be recompiled or rearranged to run on different hardware/software platforms. Rather, the bytecodes can be run in the Java Virtual Machine or passed to a (JIT) compiler that converts them into native code for a target platform on the fly.

This means that the original Java application or applet bytecode, which isn't specific or native to any one hardware platform or architecture, can be run without recompilation on any hardware or software platform that has a Java Run-Time Environment. In other words, a Java program's native architecture is the Java VM which is or will soon be available in both software and hardware implementations, making Java applications and applets multi-platform capable as long as the target system is Java enabled. As described below, the Java language has certain characteristics which allow a software developer to easily use and reuse programs written by himself or others while still providing a reason for reuse of programs or portions of programs to prevent their destruction or improper use.

Sun's Java language has emerged as an industry-recognized language, not only for "programming the Internet, but also as" . . . a serious programming language capable of tackling the most sophisticated business applications." Sun defines Java as: "a simple, object-oriented, distributed, interpreted, robust, secure, architecture-neutral, portable, high-performance, multithreaded, dynamic, buzzword-compliant, general-purpose programming language. Java supports programming for the Internet in the form of platform-independent Java applets." Java applets are small, specialized applications that comply with Sun's Java Application Programming Interface (API) allowing developers to add "interactive content" to Web documents (e.g. simple animation, page adornments, basic games, etc.). Applets execute within a Java-compatible browser (e.g. Netscape Navigator) by copying code from the server to client. From a language standpoint, Java's core feature set is based on C++. Sun's Java literature states that Java is basically "C++, with extensions from Objective C for more dynamic method resolution".

Another technology that has function and capability similar to JAVA is provided by Microsoft and its ActiveX technology, to give developers and Web designers the wherewithal to build dynamic content for the Internet and personal computers. ActiveX runs only the so-called Wintel platform (a combination of a version of Windows and an Intel microprocessor), as contrasted with Java which is a compile once, run anywhere language.

ActiveX includes tools for developing animation, 3-D virtual reality, video and other multimedia content. The tools use Internet standards, work on multiple platforms, and are being supported by over one hundred companies. The group's building blocks are called ActiveX Controls, small, fast components that enable developers to embed parts of software in hypertext markup language (HTML) pages. ActiveX Controls work with a variety of programming languages including Microsoft's Visual C++, Borland's Delphi, Microsoft's Visual Basic programming system and, in the future, Microsoft's development tool for Java, code named "Jakarta." ActiveX Technologies also includes ActiveX Server Framework, allowing developers to create server applications. One of ordinary skill in the art will readily recognize that ActiveX and ActiveX components could be substituted for JAVA and its components as their use is described herein without undue experimentation to practice the invention.

Further explanation of the Java programming language, its characteristics and advantages is not deemed necessary. Java is now well-known and many articles and texts are available which describe the language in great detail. In addition, compilers and development kits are commercially available from several vendors including SunSoft Inc., Borland International, Inc. and Microsoft Corporation. Accordingly, for reasons of brevity and clarity, additional details of the Java language and the operation of the Run-Time Environment or the JIT compilers will not be dis-

cussed further in herein since this information can be readily obtained elsewhere. One appropriate source can be found in Gosling, Joy & Steele, The Java Language Specification (1996), the disclosure of which is hereby incorporated by reference. Another source for Java VM information is Sun Microsystems' Java Virtual Machine Specification, Release 1.0 Beta DRAFT (Aug. 21, 1995), the disclosure of which is also hereby incorporated by reference.

The arrangement described above concerning the running of Java applets and applications is illustrated in FIG. **2**. This block diagram shows how a Java application or applet can be run on one or more hardware/software platform combinations. The applets can be obtained, along with the static information (text and/or graphics) of the web page they are resident on, by either an ordinary web browser or one that is Java enabled. If the applet is obtained by a non-Java enabled browser, as depicted in block **202**, it is passed via connection **203** to the Java Run-Time Environment **206** where the applet code is compiled into Java bytecode class files. The bytecode is then checked for security purposes by the bytecode verifier and then run on the Java VM by the bytecode interpreter to yield Java derived code that can be input to the optional JIT compiler **208** via connection **207** for conversion to platform native code.

Java source is compiled into bytecodes in an intermediate form instead of machine code (like C, C++, Fortran, etc.) to enable and facilitate portability. The bytecodes execute on any machine with a bytecode interpreter. Thus, Java applets and applications can and do run on a variety of client machines. Further, since the bytecodes are compact and designed to transmit efficiently over a network, Java enhances a preferred embodiment with universal clients and server-centric policies.

The output of the JIT compiler **208** is passed therefrom via connection **209** to a target platform **210**. Target platform **210** could be, for example, a Windows combination, a Macintosh System 7/PowerPC combination or a Unix/RISC combination. If the Operating System (OS) of the target platform is Java enabled, that is, if it includes its own Java Run-Time environment, then the Environment **206** output could be passed directly via connector **211** to the target platform **210** avoiding the Java JIT compiler **208** whose services would not be needed.

Alternatively, if an applet is obtained by a Java enabled browser (such as Sun's HotJava, Netscape's Navigator 3.0 or Microsoft's Internet Explorer 3.0) which includes and has already installed the Java Run-Time Environment on the computer where it resides, there is no need to utilize the separate Environment **206**. Applets so captured are passed via connector **213** through by the Java enabled browser at **212** to the Java Environment, also logically part of block **212**, where such applets are handled as described above in connection with function block **206**. Lastly, stand-alone Java applications are passed directly to the Java Environment block **206** where they are handled and processed in a similar manner to the Java applets. The Java applications do not need to be obtained nor do they work in conjunction with a browser. However, if a Java enabled browser is loaded on the developer's hardware, as is probable, a Java application can be passed directly to the browser of function block **212** via connector **215** and handled in the same manner as an applet would have been.

A preferred embodiment of an applet that will be known as the Visual Java Tool (or VJ Tool hereafter) takes the concept of objects and applies it through the entire development system to provide a development or authoring tool that is robust, easy to use and one that minimizes the amount of code a developer needs to write. VJ Tool is described herein in the context of an applet, but as it has been noted, VJ Tool could also be provided as a full application and handled in the manner described above. The user of VJ Tool would not have to be knowledgeable about Java or OOP and could build or create a Java applet or application from scratch just by using VJ Tool in the manner described herein.

FIG. **3** is a block diagram that shows the initialization process for the Visual Java Tool applet in accordance with a preferred embodiment of the invention. The applet **302** is seen by a Java enabled browser **304**, such as Sun's HotJava or Netscape's Navigator, via link **305** and then downloaded via connection **303** to the client computer on which the browser resides. Alternatively, the VJ Tool can be obtained from local storage as an application. When browser **304** is activated, it also initializes and makes the Java Run-Time Environment **306** active thereby initiating and readying the Java Virtual Machine for the eventual arrival of an applet.

Once obtained from its web page or local storage, the VJ Tool is itself initialized as shown in block **308** and made ready for interaction with a user, see block **310**. Initialization of the applet includes initialization of the desktop (VJContainer) and the web page view (VJDocument). VJContainer and VJDesktop are tightly coupled. VJContainer is a container API. The details of applet initialization for VJ Tool are included in VJContainer and VJDesktop.

For each component, a template is initially used to define the particular characteristics of the component. The template includes a start, stop, initialize, destroy, connect, disconnect, customize (edit), save, load and one or more component specific task methods. These methods are customizable for each of the components so that the sliderbar component has a different disconnect method then a button component.

The C++ source code enabling VJContainer is presented below.

```
import java.awt.*;
import java.util.*;
public class VJContainer extends VJNode {
// Attributes of this component
VJDesktop theDesktop = null;  // if NOT null the window (frame)
associated with this container node
                        // if null this is a primitive node
final static int  cut = 1;
final static int  copy = 2;
final static int  paste = 3;
int lastCommand = 0;
final static String out        = "out_nd.gif";
final static String in         = "in_nd.gif";
Vector port_info;
Vector port_name;
```

```
//final static String port1_info  = "output from container";
//final static String port1_name  = "Pin 1";
final static String url_name    = "container.html";
final static String info_name   = "A VJ Folder or container";
boolean open;
int nodeCount;                  // the number of nodes
static int instanceCount = 0;
//containerNode container;
// the panel in which contains a hierarchcal node's nodes
//
//1)  instantiate a new component on either physical or logical display
// and an optional customizer (edit) window appears.
// 2)  each customizer (edit) window is defined in the template as a
// method corresponding to the customizer (edit) method.
// 3)  Properties of the component are dynamically updated based on
// user interaction with the customizer (edit) window.
//
//
containerEditor edit;
protected Vector nodes;          // if null this is a primitive node
                                 // otherwise the nodes contained in this
hierarchical node
int thisInstance;
static Image normalImage;
static Image selectedImage;
VJ vj;

boolean outConnect[];
boolean request[];
boolean outRequest[];
int outRequestTime[];
int requestTime[];
VJNetPin thePin[];
int nextPort = 0;
VJContainer theParent;
// Constructor
public VJContainer(VJ v){
  super(v);
  vj = v;
}
public static void getImages(GIFFactory f){
   normalImage = f.GetGIF("out_nd.gif");
   selectedImage = f.GetGIF("in_nd.gif");
}
VJNode dup() {
  return null;
}
```

```
// Component Initialization
public void VJContainerInit(int x_pt, int y_pt) {
  thisInstance = instanceCount++;
  setName(new String("Container "+String.valueOf(thisInstance)));
  nodes = new Vector();
  outConnect = new boolean[20];
  request = new boolean[20];
  outRequest = new boolean[20];
  outRequestTime = new int[20];
  requestTime = new int[20];
  thePin = new VJNetPin[20];
  for(int k=0; k<20; k++) {
    outConnect[k]=false;
    request[k]=false;
    outRequestTime[k] = 0;
    requestTime[k] = 0;
    thePin[k]=null;
  }
  setNormalIcon("out_nd.gif");
  setSelectedIcon("in_nd.gif");
  setComponentURL("container.html");
  setComponentInfo("A simple VJ container");
  VJNodeInit(true,x_pt,y_pt,false);
  setImages(normalImage,selectedImage);  //Pass references to the
static images down to the node
  theDesktop = new VJDesktop(vj,this);
  theDesktop.pack();

  if(instanceCount==1){
    theDesktop.setTitle("VJ Desktop");
    theDesktop.reshape(10,30,400,640);
    theDesktop.show();
    open = true;
  } else {
    theDesktop.setTitle(getName());

theDesktop.reshape(instanceCount*20,instanceCount*20,400,460);
  }
  port_info = new Vector();
  port_name = new Vector();
  nodeRect = new Rectangle(x_pt-3,y_pt-
3,selectedImage.getWidth(vj.theContainer.theDesktop.vp_w)+3,selecte
dImage.getHeight(vj.theContainer.theDesktop.vp_w)+3);
}
public void addNewPort(VJNetPin addedPin, int i, String info, String
name){
```

```
    port_info.addElement(info);
    port_name.addElement(name);
    thePin[i] = addedPin;
    addedPin.setConnection(i);
    addPort(info,name,VJPort.InputOutput,addedPin.theLocation);    //
Pin 0
  }
  public void setParent(VJContainer p) {
    theParent = p;
  }

  public void request(int port,int time) {
    if(thePin[port]!=null) thePin[port].requestIN(time);   else {
     System.out.println("Pin connection problem");
    }
  }
  public void requestOUT(int port,int time) {
    if(outConnect[port]) vj.request(port,time,this);
    else {
     if(outRequest[port]) System.out.println("Losing previous out
request");
     outRequest[port] = true;
     outRequestTime[port] = time;
    }
  }
  public int componentID() { return 500; }
  public void disconnecting(int port) {
       if(port< 20){
         request[port] = false;
         outConnect[port] = false;
         requestTime[port] = 0;
       }
  }
  public void connecting(int port) {
       if(outRequest[port]) {
         outRequest[port] = false;
         vj.request(port,outRequestTime[port],this);
       }
  }
  public void load(String s) {
  }
  public String save() {
    return "";
  }

  public void set(Object o,int port,int time) {
       //System.out.println("set IN port "+port);
```

```
        if(port< 20){
          thePin[port].setIN(o,time);
        }
    }
    public void setOUT(Object o,int port,int time) {
        //System.out.println("set OUT port "+port);
        if(port< 20){
          vj.set(o,port,time,this);
        }
    }
    public void propertiesEditor() {
      if(!theDesktop.isShowing()||!theDesktop.isVisible())
    theDesktop.show();
      if(edit==null && thisInstance > 0){
        edit = new containerEditor((Frame)(vj.theFrame),this);
        edit.pack();
        edit.resize(6*32,6*32);
        edit.show();
      }
    }
    public void init(){
      for(Enumeration e = nodes.elements() ; e.hasMoreElements() ;) {
          VJNode vjn = (VJNode) e.nextElement();
          vjn.init();
      }
    };
    public void start(){
      if(open) theDesktop.show();
      for(Enumeration e = nodes.elements() ; e.hasMoreElements() ;) {
          VJNode vjn = (VJNode) e.nextElement();
          vjn.start();
      }
    };
    public void stop(){
      if(open) theDesktop.hide();
      for(Enumeration e = nodes.elements() ; e.hasMoreElements() ;) {
          VJNode vjn = (VJNode) e.nextElement();
          vjn.stop();
      }
    };
    public void destroy(){};
    public synchronized void addNode(Object o) {
      //System.out.println("Adding node");
      nodes.addElement(o);
    }
    public void doSelectAll(){
      for(Enumeration e = nodes.elements() ; e.hasMoreElements() ;) {
```

```
        VJNode vjn = (VJNode) e.nextElement();
        vjn.setSelected(true);
      }
      theDesktop.vp_w.repaint();
      vj.theDocument.repaint();
    }
    public void editComponent(){
      for(Enumeration e = nodes.elements() ; e.hasMoreElements() ;) {
        VJNode vjn = (VJNode) e.nextElement();
        if(vjn.getSelected()) vjn.propertiesEditor();
      }
    }
    public void doCut(){
      lastCommand = cut;
      vj.nodePasteBoard.removeAllElements();
      getSubnet(true);
    }
    public void doCopy(){
      lastCommand = copy;
      vj.nodePasteBoard.removeAllElements();
      getSubnet(false);
    }
    public void doPaste(){
      int k,vCount=0;
      VJNode theSRCNode = null;
      if(lastCommand==copy){
        vCount = theDesktop.vp_w.container.nodes.size();
      }
      for(Enumeration e = vj.nodePasteBoard.elements() ;
    e.hasMoreElements() ;) {
        VJNode vjn = (VJNode) e.nextElement();
        VJNode vjn_c;
        if(lastCommand==copy) {
          vjn_c = vjn.dup();
          if(vjn_c==null) {
            System.out.println("duplication failed in doPaste");
            return;
          }
          for(k=0; k<vjn.getNumberOfPorts();k++){
            VJNode tn = vjn.getConnectingNode(k);
            if(tn!=null && tn.getSelected()){
              vjn_c.setConnectingPort(k,vjn.getConnectingPort(k));
              vjn_c.setToDraw(k,vjn.getToDraw(k));
            } else {
              vjn_c.setConnectingPort(k,0);
              vjn_c.setConnectingNode(k,null);
              vjn_c.setToDraw(k,false);
```

```
            }
          }
          if(vjn.isUINode)
    vj.theDocument.clearLite(vj.theDocument.getGraphics(),vjn.comp.bou
    nds());
        } else {
          vjn_c = vjn;
        }
        theDesktop.vp_w.container.addNode(vjn_c);
        if(vjn_c.isUINode) vj.theDocument.add(vjn_c.comp);
      }
      if(lastCommand==copy){
        int where = vCount;
        for(Enumeration e1 = vj.nodePasteBoard.elements() ;
    e1.hasMoreElements() ;) {
          VJNode vjn1 = (VJNode) e1.nextElement();
          for(k=0; k<vjn1.getNumberOfPorts();k++){
            VJNode cn = vjn1.getConnectingNode(k);
            if(cn!=null){
              int m = vj.nodePasteBoard.indexOf(cn);
              if(m>=0)
              try {
                theSRCNode = (VJNode) nodes.elementAt(where);
                VJNode theDSTNode = (VJNode)
    nodes.elementAt(vCount+m);
                theSRCNode.setConnectingNode(k,theDSTNode);
              } catch(Exception e) {
                System.out.println("doPaste "+ e);
              }
            }
          }
          where++;
        }
        for(Enumeration e1 = vj.nodePasteBoard.elements() ;
    e1.hasMoreElements() ;) {
          VJNode vjn1 = (VJNode) e1.nextElement();
          vjn1.setSelected(false);
        }
      }
      theDesktop.vp_w.repaint();
      vj.theDocument.repaint();
      doCopy();
      //DUMP();
    }
    public synchronized void DUMP() {
      for(Enumeration e = nodes.elements() ; e.hasMoreElements() ;) {
        VJNode vjn = (VJNode) e.nextElement();
```

-27-

```
        System.out.print("Node"+vjn.name);
        for(int k=0; k<vjn.getNumberOfPorts();k++){
          System.out.print(" port "+k);
          System.out.print(" XPt["+k+"]="+vjn.getXPt(k));
          System.out.print(" YPt["+k+"]="+vjn.getYPt(k));
          if(vjn.getToDraw(k))System.out.print(" ToDraw=true"); else
System.out.print(" ToDraw=false");
          System.out.print(" ctpt "+vjn.getConnectingPort(k));
          if(vjn.getConnectingNode(k)==null)
            System.out.print(" NO cn ");
          else
            System.out.print(" cn "+vjn.getConnectingNode(k).name);
        }
        System.out.println(" ");
      }
    }

    public synchronized void getSubnet(boolean isCut) {
      for(Enumeration e = nodes.elements() ; e.hasMoreElements() ;) {
        VJNode vjn = (VJNode) e.nextElement();
        if(vjn.getSelected()){
          vj.nodePasteBoard.addElement(vjn);
          if(isCut){
            if(vjn.isUINode){

vj.theDocument.clearLite(vj.theDocument.getGraphics(),vjn.comp.bou
nds());
            }
            theDesktop.vp_w.clearArea(vjn.nodeRect);
            if(vjn.isUINode){
              vj.theDocument.remove(vjn.comp);
            }
          }
          for(int k=0; k<vjn.getNumberOfPorts();k++){
            int cp = vjn.getConnectingPort(k);
            VJNode vj_c = vjn.getConnectingNode(k);
              if(vj_c!=null && isCut){
                Graphics g = theDesktop.vp_w.getGraphics();
                int xbeg = vjn.getXPt(k);
                int ybeg = vjn.getYPt(k);
                int xend = vj_c.getXPt(cp);
                int yend = vj_c.getYPt(cp);
                if(xbeg<xend) {
                  if(ybeg<yend)
                    g.clearRect(xbeg,ybeg,xend-xbeg,yend-ybeg);
                  else
                    g.clearRect(xbeg,yend,xend-xbeg,ybeg-yend);
```

```
            } else {
              if(ybeg<yend)
                g.clearRect(xend,ybeg,xbeg-xend,yend-ybeg);
              else
                g.clearRect(xend,yend,xbeg-xend,ybeg-yend);
            }
          }
          if(vj_c!=null&&isCut)
          if(!vj_c.getSelected()){
            vj_c.setConnectingNode(cp,null);
            vj_c.setConnectingPort(cp,0);
            vj_c.setXPt(cp,0);
            vj_c.setYPt(cp,0);
            vj_c.setToDraw(cp,false);
            vjn.setConnectingNode(k,null);
            vjn.setConnectingPort(k,0);
            vjn.setXPt(k,0);
            vjn.setYPt(k,0);
            vjn.setToDraw(k,false);
          }
        }
        if(isCut){
          if(!nodes.removeElement(vjn))
            System.out.println("VJ Error unable remove deleted node");
          getSubnet(isCut);
          return;
        }
      }
    }
    if(isCut)theDesktop.vp_w.repaint();
  }

  public synchronized void deleteNode() {
    for(Enumeration e = nodes.elements() ; e.hasMoreElements() ;) {
      VJNode vjn = (VJNode) e.nextElement();
      if(vjn.getSelected()){
        if(vjn.isUINode){

vj.theDocument.clearLite(vj.theDocument.getGraphics(),vjn.comp.bou
nds());
        }
        theDesktop.vp_w.clearArea(vjn.nodeRect);
        if(vjn.isUINode){
          vj.theDocument.remove(vjn.comp);
        }
        for(int k=0; k<vjn.getNumberOfPorts();k++){
          int cp = vjn.getConnectingPort(k);
```

```
            if(cp>=0){
              VJNode vj_c = vjn.getConnectingNode(k);
              {
                Graphics g = theDesktop.vp_w.getGraphics();
                int xbeg = vjn.getXPt(k);
                int ybeg = vjn.getYPt(k);
                int xend = vj_c.getXPt(cp);
                int yend = vj_c.getYPt(cp);
                if(xbeg<xend) {
                  if(ybeg<yend)
                    g.clearRect(xbeg,ybeg,xend-xbeg,yend-ybeg);
                  else
                    g.clearRect(xbeg,yend,xend-xbeg,ybeg-yend);
                } else {
                  if(ybeg<yend)
                    g.clearRect(xend,ybeg,xbeg-xend,yend-ybeg);
                  else
                    g.clearRect(xend,yend,xbeg-xend,ybeg-yend);
                }
                vj_c.setConnectingNode(cp,null);
                vj_c.setConnectingPort(cp,-1);
                vj_c.setXPt(cp,-1);
                vj_c.setYPt(cp,-1);
                vj_c.resetToDraw(cp);
              }
            }
          }
          if(!nodes.removeElement(vjn))
            System.out.println("VJ Error unable remove deleted node");
          deleteNode();
          return;
        }
      }
      theDesktop.vp_w.repaint();
    }

    public synchronized void selectNode() {
    }
    public synchronized void drawNet(Graphics g) {
      Image img;
      for(Enumeration e = nodes.elements() ; e.hasMoreElements() ;) {
        VJNode vjn = (VJNode) e.nextElement();
        if(vjn.getSelected())
          img = vjn.getSelectedIcon();
        else
          img = vjn.getNormalIcon();
        if(img!=null) theDesktop.drawNode(img,vjn.x,vjn.y);
```

```
        for(int
    i=0;i<vjn.getNumberOfPorts();i++)HOTSPOTS.drawHotspot(vjn,i,g);
        //System.out.println("The name = "+vjn.name);
      }
      for(Enumeration e1 = nodes.elements() ; e1.hasMoreElements() ;) {
        VJNode vjn = (VJNode) e1.nextElement();
        for(int j=0; j<vjn.getNumberOfPorts(); j++)
          if(vjn.getToDraw(j)){
            g.drawLine(vjn.getXPt(j),
                       vjn.getYPt(j),

    vjn.getConnectingNode(j).getXPt(vjn.getConnectingPort(j)),

    vjn.getConnectingNode(j).getYPt(vjn.getConnectingPort(j))
                       );
          }
      }
    }
    public synchronized void resetSelected() {
      for(Enumeration e = nodes.elements() ; e.hasMoreElements() ;) {
        VJNode vjn = (VJNode) e.nextElement();
        if(vjn.getSelected()){
          vjn.setSelected(false);
        }
      }
    }
    } // end class VJContainer
```

The source code enabling the container editor for modifying properties of the container is presented below. When a new component is instantiated on either the physical or logical display, an optional customizer (edit) window is presented if a containerEditor method is defined for the component. The customizer (edit) window is defined in the template as a method corresponding to the customizer (edit) method. The method contains the logic facilitating the dynamic definition of properties of the component and the update of the properties based on user interaction with the customizer (edit) window.

```
class containerEditor extends Frame
{
```

```
// Attributes
VJContainer vjc;
Button ok;
Button cancel;
boolean dirty;
Panel centerPanel;
Polygon p_v[];
boolean selected[];
TextField tf;
public containerEditor (Frame parent,VJContainer l)
  {
    super("Click to select pins");
    vjc = l;
      setBackground(Color.lightGray);
    setLayout(new BorderLayout());
    Panel p = new Panel();
    Panel n = new Panel();
    n.add(new Label("Name"));
    tf = new TextField(vjc.getName());
    n.add(tf);
    add("North",n);
    centerPanel = new Panel();
    p_v = new Polygon[20];
    selected = new boolean[20];
    for(int m=0; m<20;m++) if(vjc.thePin[m]!=null) selected[m]=true;
else selected[m]=false;
    p.add(new Button("OK"));
      p.add(new Button("Cancel"));
    add("South",p);
    int xport[] = new int[5];
    int yport[] = new int[5];
    int xStart = 90-1;
    int yStart = 45-1;
    int x,y;
    int i_width =
(vjc.normalImage.getWidth(vjc.vj.theContainer.theDesktop.vp_w))*3-6;
    int i_height =
(vjc.normalImage.getHeight(vjc.vj.theContainer.theDesktop.vp_w))*3-6;
    for(int direction=0; direction<4; direction++)
      for(int k = 0; k<5; k++) {
        switch(direction){
            case 0:  x = xStart+7+i_width;
                     y = yStart+3+k*(i_height/4);
                     break;
            case 1:  x = xStart+3+k*(i_width/4);
                     y = yStart;
                     break;
```

```
                case 2:  x = xStart;
                         y = yStart+3+k*(i_height/4);
                         break;
                default: x = xStart+3+k*(i_width/4);
                         y = yStart+i_height+7;
                         break;
            }
            for(int i=0;i<5;i++){
               xport[i] = HOTSPOTS.IOx_offset[direction][i]+x;
               yport[i] = HOTSPOTS.IOy_offset[direction][i]+y;
            }
            p_v[k+direction*5] = new Polygon(xport,yport,5);
         }
      }
      public void paint(Graphics g){

      g.drawImage(vjc.normalImage,90,45,vjc.normalImage.getWidth(vjc.vj.t
      heContainer.theDesktop.vp_w)*3,

      vjc.normalImage.getHeight(vjc.vj.theContainer.theDesktop.vp_w)*3,
                this);
        for(int k=0;k<20;k++) if(selected[k]) g.fillPolygon(p_v[k]);
                          else g.drawPolygon(p_v[k]);
      }
      public boolean handleEvent(Event evt)
        { int k,x,y;
          switch(evt.id){
              case Event.MOUSE_DOWN:
                 for(k=0;k<20;k++)
      if(p_v[k].getBoundingBox().inside(evt.x,evt.y)) {
                    selected[k]=!selected[k];

      repaint(p_v[k].getBoundingBox().x,p_v[k].getBoundingBox().y,p_v[k].get
      BoundingBox().width,p_v[k].getBoundingBox().height);
                 }
                 return true;
               case Event.ACTION_EVENT:
                     if("OK".equals(evt.arg))       {
                    vjc.edit = null;
                    vjc.setName(tf.getText());
                    vjc.theDesktop.setTitle(tf.getText());
                    vjc.resetSelected();
                    int nextPort = 0;
                    for(int direction=0; direction<4; direction++)
                      for(k = 0; k<5; k++) {
                        switch(direction){
                          case 0:  x = 290;
```

```
                        y = 100+k*(200/4);
                        break;
                    case 1:  x = 50+k*(200/4);
                        y = 70;
                        break;
                    case 2:  x = 10;
                        y = 100+k*(200/4);
                        break;
                    default: x = 50+k*(200/4);
                        y = 340;
                        break;
                }

if(selected[k+direction*5]&&vjc.thePin[k+direction*5]==null){
                    VJNetPin vjnp = new VJNetPin(vjc.vj);
                    vjnp.setContainer(vjc);
                    vjnp.theLocation = k+direction*5;
                    vjc.addNewPort(vjnp,nextPort++,"fred","jim");
                    vjnp.VJNetPinInit(x,y);
                    vjnp.init();
                    vjc.addNode((Object)vjnp);
                    vjnp.setSelected(true);
                }
            }
            vjc.theDesktop.show();
            vjc.open = true;
            vjc.theParent.theDesktop.vp_w.repaint();
                dispose();
                return true;
            }

            if("Cancel".equals(evt.arg)){
              vjc.edit = null;
              vjc.theDesktop.show();
              dispose();
              return true;
            }

            return false;
          default:
              return false;
      }
}
} // end class containerEditor
class HOTSPOTS extends Object {
    final static int Ix_offset[][] =  { {0,4,4,0}, {0,4,-4,0},{0,-4,-4,0},{0,-
4,4,0}};
```

```
    final static int Iy_offset[][] =  { {0,4,-4,0}, {0,-4,-4,0},{0,-
4,4,0},{0,4,4,0}};
    final static int Ox_offset[][] =  { {0,0,4,0,0}, {0,4,0,-4,0},{0,0,-
4,0,0},{0,4,0,-4,0}};
    final static int Oy_offset[][] =  { {0,4,0,-4,0}, {0,0,-4,0,0},{0,-
4,0,4,0},{0,0,4,0,0}};
    final static int IOx_offset[][] =  { {0,4,8,4,0}, {0,4, 0,-4,0},{0,-4,-8,-
4,0},{0,-4,0,4,0}};
    final static int IOy_offset[][] =  { {0,4,0,-4,0}, {0,-4,-8,-4,0},{0,-
4,0,4,0},{0,4,8,4,0}};
     final static int xport[] = new int[5];
    final static int yport[] = new int[5];
    final static int East    = 0;
    final static int North   = 1;
    final static int South   = 3;
    final static int West    = 2;
  public HOTSPOTS() { }
   public static int getSide(int i){
    if(i<5) return East; //North;
    if(i<10) return North; //South;
    if(i<15) return West; //East;
    return South;  //West;
   }
   public static void drawHotspot(VJNode node, int l, Graphics g){
     Dimension hotSpot = new Dimension();
     hotSpot = getHotSpot(node.nodeRect,node.x-1,node.y-
1,node.getPortLocation(l));
    int direction = getSide(node.getPortLocation(l));
    int port_type = node.getPortType(l);
    int x = hotSpot.width;
    int y = hotSpot.height;
    int i;
    switch(port_type){
     case 0:
       for(i=0;i<4;i++) {
         xport[i] = Ix_offset[direction][i]+x;
         yport[i] =Iy_offset[direction][i]+y;
       };
      break;
     case 1:
       for(i=0;i<5;i++) {
         xport[i] = Ox_offset[direction][i]+x;
         yport[i] = Oy_offset[direction][i]+y;
       };
       break;
     case 2:
       for(i=0;i<5;i++) {
```

```
                xport[i] = IOx_offset[direction][i]+x;
                yport[i] = IOy_offset[direction][i]+y;
              };
              break;
          default: System.out.println("Unknown type "+port_type); break;
        }
        if(port_type==0)
          g.drawPolygon(xport,yport,4);
        else
          g.drawPolygon(xport,yport,5);
    }
//    public static Dimension getHotSpot(VJNode node,int location){
    public static Dimension getHotSpot(Rectangle nRect,int xNode,int
yNode, int location){
//          int xNode = node.x;
//          int yNode = node.y;
//          Rectangle nRect = node.nodeRect;
          int left = (nRect.width+1)/4;
          int center = (nRect.width+1)/2;
          int right = center+left;
          int top = (nRect.height+1)/4;
          int middle = (nRect.height+1)/2;
          int bottom = top+middle;
          int x,y;
           switch(location){
              case VJPort.NorthLeft:          x = xNode;
y=yNode; break;
              case VJPort.NorthLeftCenter:    x = xNode+left;
y=yNode; break;
              case VJPort.NorthCenter:        x = xNode+center;
y=yNode; break;
              case VJPort.NorthRightCenter:   x = xNode+right;
y=yNode; break;
              case VJPort.NorthRight:         x = xNode+nRect.width;
y=yNode; break;
              case VJPort.SouthLeft:          x = xNode;
y=yNode+nRect.height; break;
              case VJPort.SouthLeftCenter:    x = xNode+left;
y=yNode+nRect.height; break;
              case VJPort.SouthCenter:        x = xNode+center;
y=yNode+nRect.height; break;
              case VJPort.SouthRightCenter:   x = xNode+right;
y=yNode+nRect.height; break;
              case VJPort.SouthRight:         x = xNode+nRect.width;
y=yNode+nRect.height; break;
              case VJPort.EastTop:            x = xNode+nRect.width;
y=yNode; break;
```

```
                case VJPort.EastTopCenter:      x = xNode+nRect.width;
y=yNode+top; break;
                case VJPort.EastCenter:         x = xNode+nRect.width;
y=yNode+middle; break;
                case VJPort.EastBottomCenter:   x = xNode+nRect.width;
y=yNode+bottom; break;
                case VJPort.EastBottom:         x = xNode+nRect.width;
y=yNode+nRect.height; break;
                case VJPort.WestTop:            x = xNode;
y=yNode; break;
                case VJPort.WestTopCenter:      x = xNode;
y=yNode+top; break;
                case VJPort.WestCenter:         x = xNode;
y=yNode+middle; break;
                case VJPort.WestBottomCenter:   x = xNode;
y=yNode+bottom; break;
                default:                        x = xNode;
y=yNode+nRect.height; break;/*
                case VJPort.NorthLeft:          x = xNode;
y=yNode; break;
                case VJPort.NorthLeftCenter:    x = xNode+left;
y=yNode; break;
                case VJPort.NorthCenter:        x = xNode+center;
y=yNode; break;
                case VJPort.NorthRightCenter:   x = xNode+right;
y=yNode; break;
                case VJPort.NorthRight:         x = xNode+nRect.width;
y=yNode; break;
                case VJPort.SouthLeft:          x = xNode;
y=yNode+nRect.height; break;
                case VJPort.SouthLeftCenter:    x = xNode+left;
y=yNode+nRect.height; break;
                case VJPort.SouthCenter:        x = xNode+center;
y=yNode+nRect.height; break;
                case VJPort.SouthRightCenter:   x = xNode+right;
y=yNode+nRect.height; break;
                case VJPort.SouthRight:         x = xNode+nRect.width;
y=yNode+nRect.height; break;
                case VJPort.EastTop:            x = xNode+nRect.width;
y=yNode; break;
                case VJPort.EastTopCenter:      x = xNode+nRect.width;
y=yNode+top; break;
                case VJPort.EastCenter:         x = xNode+nRect.width;
y=yNode+middle; break;
                case VJPort.EastBottomCenter:   x = xNode+nRect.width;
y=yNode+bottom; break;
```

```
                case VJPort.EastBottom:         x = xNode+nRect.width;
y=yNode+nRect.height; break;
                case VJPort.WestTop:            x = xNode;
y=yNode; break;
                case VJPort.WestTopCenter:      x = xNode;
y=yNode+top; break;
                case VJPort.WestCenter:         x = xNode;
y=yNode+middle; break;
                case VJPort.WestBottomCenter:   x = xNode;
y=yNode+bottom; break;
                default:                        x = xNode;
y=yNode+nRect.height; break;*/
            }
            return new Dimension(x,y);
    }
}
VJDesktop is coded as follows:
import java.util.*;
import java.awt.*;
public class VJDesktop extends Frame{
    final String FILEMENU               = "File";
    final String NEWMENUITEM                = "New";
    final String OPENMENUITEM           = "Open...";
    final String SAVEMENUITEM           = "Save";
    final String SAVEASMENUITEM         = "Save As...";
    final String CLOSEMENUITEM          = "Close";
    final String EXITMENUITEM           = "Exit";
    final String SEPARATORMENUITEM      = "-";
    final String INFOMENUITEM           = "View catalogue entry for
current component ...";
    final String EDITMENU               = "Edit";
    final String UNDOMENUITEM           = "Undo";
    final String EDITMENUITEM           = "Edit Component";
    final String CUTMENUITEM                = "Cut";
    final String COPYMENUITEM           = "Copy";
    final String PASTEMENUITEM          = "Paste";
    final String ALLMENUITEM            = "Select All";
    final String CLEARMENUITEM          = "Clear All";
    final String APPLETMENU             = "Environment";
    final String RESETMENUITEM          = "Reset all components";
    final String COMPILEMENUITEM        = "Create standalone applet";
    final String HELPMENU               = "Help";
    final String ABOUTMENUITEM          = "About Visual Java";
    final String HELPTOPICSMENUITEM = "Help Topics";
    final static String EMPTY = "";
    Image in_controls[] = new Image[21];
    Image out_controls[] = new Image[21];
```

```
Image xy,wh;
int current;
int cnt;
Toolbar tools;
int status=0;
containerNode vp_w;
VJContainer container;
VJ applet_w;
boolean editorOpen=false;
String user = EMPTY;
String password = EMPTY;
Vector nodePasteBoard;
public VJDesktop(VJ  v, VJContainer n) {
   Panel centerPanel = new Panel();
   applet_w = v;
   container = n;
   MenuBar mb = new MenuBar();
   Menu m = new Menu(FILEMENU);
   m.add(new MenuItem(NEWMENUITEM));
   m.add(new MenuItem(OPENMENUITEM));
   m.add(new MenuItem(SAVEMENUITEM));
   m.add(new MenuItem(SAVEASMENUITEM));
   m.add(new MenuItem(SEPARATORMENUITEM));
   m.add(new MenuItem(CLOSEMENUITEM));
   m.add(new MenuItem(EXITMENUITEM));
   mb.add(m);
   Menu m1 = new Menu(EDITMENU );
   m1.add(new MenuItem(UNDOMENUITEM));
   m1.add(new MenuItem(SEPARATORMENUITEM));
   m1.add(new MenuItem(CUTMENUITEM));
   m1.add(new MenuItem(COPYMENUITEM));
   m1.add(new MenuItem(PASTEMENUITEM));
   m1.add(new MenuItem(ALLMENUITEM));
   m1.add(new MenuItem(CLEARMENUITEM));
   m1.add(new MenuItem(EDITMENUITEM));
   mb.add(m1);
   Menu m2 = new Menu(APPLETMENU);
   m2.add(new MenuItem(INFOMENUITEM));
   m2.add(new MenuItem(RESETMENUITEM));
   m2.add(new MenuItem(COMPILEMENUITEM));
   mb.add(m2);
   Menu m3 = new Menu(HELPMENU);
   m3.add(new MenuItem(ABOUTMENUITEM ));
   m3.add(new MenuItem(SEPARATORMENUITEM));
   m3.add(new MenuItem(HELPTOPICSMENUITEM ));
   mb.add(m3);
   setMenuBar(mb);
```

```
        tools = new Toolbar(applet_w,true);
          doImages();
        add("West",tools);
        vp_w = new containerNode(applet_w, container);
        add("Center",vp_w);
          setBackground(new Color(0,190,255));
    }
    public void paint(Graphics g) {
        int h_off,v_off;
        if(applet_w.isMicrosoft){  h_off = 0;  v_off=0; } else {
            h_off=insets().left;  v_off=insets().top; }
        for(int i=0;i<cnt;i++) {
          int h = (i%12)*23+h_off;
          int v =(i/12)*22+v_off;
          if(i == current && i <= (cnt-1))
g.drawImage(in_controls[i],h,v,this);
            else g.drawImage(out_controls[i],h,v,this);
        }
    }
    public boolean handleEvent(Event evt) {
    int h,v;
      if (evt.id == Event.ACTION_EVENT){
        if (evt.target instanceof MenuItem) {
          String label = (String)evt.arg;
          if (label.equals(NEWMENUITEM)) {
          } else if (label.equals(OPENMENUITEM)) {
          } else if (label.equals(SAVEMENUITEM)) {
          } else if (label.equals(SAVEASMENUITEM)) {
          } else if (label.equals(CLOSEMENUITEM)) {
            if(container.thisInstance>0) {
                container.open = false; hide(); }
          } else if (label.equals(EXITMENUITEM)) {
          } else if (label.equals(INFOMENUITEM)) {
          } else if (label.equals(UNDOMENUITEM)) {
            doPaste();
          } else if (label.equals(CUTMENUITEM)) {
            doCut();
          } else if (label.equals(COPYMENUITEM)) {
            doCopy();
          } else if (label.equals(PASTEMENUITEM)) {
            doPaste();
          } else if (label.equals(ALLMENUITEM)) {
            doSelectAll();
          } else if (label.equals(CLEARMENUITEM)) {
            doSelectAll();
            doCut();
          } else if (label.equals(EDITMENUITEM)) {
```

```
                editComponent();
              } else if (label.equals(RESETMENUITEM)) {
              } else if (label.equals(COMPILEMENUITEM)) {
              } else if (label.equals(ABOUTMENUITEM)) {
              } else if (label.equals(HELPTOPICSMENUITEM)) {
              }
              return true;
            }
          }
          if (evt.id == Event.WINDOW_DESTROY) {
            return true;
          }
                if (evt.id==Event.MOUSE_EXIT){
                }
                if (evt.id==Event.MOUSE_MOVE){
                }
                if (evt.id==Event.MOUSE_DOWN){
                }
          //System.out.print(evt.toString());
          return super.handleEvent(evt);
        }
      public void doSelectAll(){
        if(applet_w.loading) { System.out.println("Loading VJ"); return; }
        container.doSelectAll();
      }
      public void doCut(){
        if(applet_w.loading) { System.out.println("Loading VJ"); return; }
        container.doCut();
      }
      public void editComponent(){
        if(applet_w.loading) { System.out.println("Loading VJ"); return; }
        container.editComponent();
      }
      public void doCopy(){
        if(applet_w.loading) { System.out.println("Loading VJ"); return; }
        container.doCopy();
      }
      public void doPaste(){
        if(applet_w.loading) { System.out.println("Loading VJ"); return; }
        container.doPaste();
      }
      public void doImages() {
              GIFFactory factory = new GIFFactory(applet_w);
              VJCInterface.getImages(factory);
              VJContainer.getImages(factory);
              VJNetPin.getImages(factory);
              VJPlus.getImages(factory);
```

```
            VJBiCopy.getImages(factory);
            VJEquals.getImages(factory);
            VJConstant.getImages(factory);
            VJRandom.getImages(factory);
            VJCounter.getImages(factory);
            VJURLOpener.getImages(factory);
            VJSplit.getImages(factory);

    tools.addItem(factory.GetGIF("in_cu.gif"),factory.GetGIF("out_cu.gif"));

    tools.addItem(VJContainer.selectedImage,VJContainer.normalImage);

    //tools.addItem(VJNetPin.selectedImage,VJNetPin.normalImage);
            tools.addItem(VJPlus.selectedImage,VJPlus.normalImage);

    tools.addItem(VJBiCopy.selectedImage,VJBiCopy.normalImage);

    tools.addItem(VJEquals.selectedImage,VJEquals.normalImage);

    tools.addItem(VJConstant.selectedImage,VJConstant.normalImage);

    tools.addItem(VJRandom.selectedImage,VJRandom.normalImage);

    tools.addItem(VJCounter.selectedImage,VJCounter.normalImage);

    tools.addItem(VJURLOpener.selectedImage,VJURLOpener.normalImag
    e);
            tools.addItem(VJSplit.selectedImage,VJSplit.normalImage);

        }
        public String deskInfo(int ii){
          switch(ii){
            case 3: return "GGGG"; //VJButton.quick_info;
            default: return EMPTY;
          }
        }
        public String browserInfo(int ii){
          switch(ii){
            case 3: return "KKKKKKK"; //VJTextField.quick_info;
            default: return EMPTY;
          }
        }
        public void update(Graphics g) {
              paint(g);
        }
      public void drawNode(Image img,int x, int y){
```

```
            vp_w.drawNode(img,x,y);
        }
    }
    class containerNode extends Panel {

        boolean marquee;
        boolean drag;
        boolean connecting;
        boolean disconnecting;
        int xbeg,xend,ybeg,yend;
        int left,top,right,bottom;
        int xleft,xright,ytop,ybottom;
        int current_i;
        int current_port;
        int portInfo;
        VJNode current_node;
        int current_comp_node;
        int downType;
        int inset_h,inset_v;
        boolean firstTime = true;
        boolean portInfoDrawn = false;
        boolean nodeInfoDrawn = false;
        static long lastTime=0;
        VJ app;
        VJContainer container;
         public containerNode(VJ v, VJContainer n) {
            super();
            setLayout(null);
            disconnecting = false;
            app = v;
            container = n;
         }
         public boolean closeEnough(int fx, int fy,int x, int y,int epsilon){
             return x <fx+epsilon && x >fx-epsilon && y <fy+epsilon && y
    >fy-epsilon;
         }

    public void doNodeSelection(VJNode vjn,boolean cntDwn,int x, int y){
        if(!cntDwn) {
          beginDrag(x,y);
          if(!vjn.getSelected()) {
            app.theDocument.clearlight(app.theDocument.getGraphics());
            container.resetSelected();  // reset all nodes in container to
    unselected
            vjn.setSelected(true);      // select the current node
            app.theDocument.highlight(app.theDocument.getGraphics());
          }
```

```
        current_node = vjn;
        repaint();
      } else {
        if(vjn.getSelected()) {
          Rectangle r = vjn.nodeRect;
          vjn.setSelected(false);
          if(vjn.isUINode)

app.theDocument.clearLite(app.theDocument.getGraphics(),vjn.comp.
bounds());
          getGraphics().clearRect(r.x-4,r.y-4,r.width+12,r.height+12);
          for(Enumeration e2 = container.nodes.elements() ;
e2.hasMoreElements() ;) {
            VJNode vjn2 = (VJNode) e2.nextElement();
            if(vjn2.getSelected()) {
                repaint();
              return;
               }
          }
        } else {
          vjn.setSelected(true);
          if(vjn.isUINode)

app.theDocument.drawLite(app.theDocument.getGraphics(),vjn.comp.
bounds());
          repaint();
          return;
        }
      }
    }
    public VJNode onNode(int x, int y){
      for(Enumeration e = container.nodes.elements() ;
e.hasMoreElements() ;) {
          VJNode vjn = (VJNode) e.nextElement();
          if(vjn.nodeRect.inside(x,y)) {
            //System.out.println("On node "+vjn.name);
            return vjn;
          }
      }
      return null;
    }
    public VJNode onPort(int x, int y){
      Dimension d;
      current_port = -1;
      for(Enumeration e = container.nodes.elements() ;
e.hasMoreElements() ;) {
          VJNode vjn = (VJNode) e.nextElement();
```

```
      for(int k=0; k<vjn.getNumberOfPorts();k++){
        d =
HOTSPOTS.getHotSpot(vjn.nodeRect,vjn.x,vjn.y,vjn.getPortLocation(k))
;
          if(closeEnough(d.width,d.height,x,y,8)) {
              //System.out.println("On port ="+k+" of Node "+vjn.name);
            current_port = k;
            return vjn;
          }
        }
      }
    return null;
}
public boolean bigEnough(){
    return xbeg-yend !=0 && ybeg-xbeg!=0;
}
public void beginConnection(int x, int y){
    VJNode cn_beg;
    int cp_beg;
    connecting = true;
    if(disconnecting){
      if(current_node == null || current_port == -1){
        System.out.println("VJDesktop/doNodeSelection node or port
not set");
          return;                    // May need to do more work before/after
return
      }
      cn_beg = current_node.getConnectingNode(current_port);
      cp_beg = current_node.getConnectingPort(current_port);
      if(cn_beg==null) System.out.println("How can we be disconnecting
?");
      xbeg = cn_beg.getXPt(cp_beg);
      ybeg = cn_beg.getYPt(cp_beg);
      xend = current_node.getXPt(current_port);
      yend = current_node.getYPt(current_port);
    } else {
      xbeg = x ;
      ybeg = y ;
      xend = x ;
      yend = y ;
      Graphics g = getGraphics();
      g.setXORMode(Color.white);
      g.drawLine(xbeg, ybeg, xend ,yend);
    }
}
public void doConnection(int x, int y){
    //System.out.println("DO CONNECTION");
```

```
    Graphics g = getGraphics();
    g.setXORMode(Color.white);
    g.drawLine(xbeg, ybeg, xend ,yend);
    xend = x ;
    yend = y ;
    g.drawLine(xbeg, ybeg, xend ,yend);
  }
  public void endConnection(int x, int y){
    int srcPort;
    VJNode srcNode;
    //System.out.println("END CONNECTION");
    Graphics g = getGraphics();
    g.setXORMode(Color.white);
    g.drawLine(xbeg, ybeg, xend ,yend);
    xend = x ;
    yend = y ;
    connecting = false;
    srcNode = current_node;
    if(srcNode==null) System.out.println("srcNode =null?");
    srcPort = current_port;
    current_node=onPort(x,y);
    VJNode vj_c = srcNode.getConnectingNode(srcPort);
    if(vj_c==null) System.out.println("vj_c =null?");
    int vj_p =  srcNode.getConnectingPort(srcPort);
    if(disconnecting && current_node==null){
      int xb = srcNode.getXPt(srcPort);
      int xe = vj_c.getXPt(vj_c.getConnectingPort(srcPort));
      int yb = srcNode.getYPt(srcPort);
      int ye = vj_c.getYPt(vj_c.getConnectingPort(srcPort));
      if(xb < xe) {
        if(yb < ye)
          g.clearRect( xb-2, yb-2, xe - xb+4, ye - yb+4 );
        else
          g.clearRect( xb-2, ye-2, xe - xb+4, yb - ye+4 );
      } else {
        if(yb < ye)
          g.clearRect( xe-2, yb-2, xb - xe+4, ye - yb+4 );
        else
          g.clearRect( xe-2, ye-2, xb - xe+4, yb - ye+4 );
      }
      vj_c.disconnecting(srcNode.getConnectingPort(srcPort));
      srcNode.disconnecting(srcPort);
      vj_c.setConnectingNode(srcNode.getConnectingPort(srcPort),null);
      vj_c.setConnectingPort(vj_p,0);
      vj_c.setXPt(vj_p,0);
      vj_c.setYPt(vj_p,0);
      vj_c.setToDraw(vj_p,false);
```

```
        srcNode.setToDraw(srcPort,false);
        srcNode.setConnectingNode(srcPort,null);
        srcNode.setConnectingPort(srcPort,0);
        srcNode.setXPt(srcPort,0);
        srcNode.setYPt(srcPort,0);
        disconnecting = false;
        return;
      }
      if(current_node!=null &&
    compatible(srcNode,srcPort,current_node,current_port)) {
        if(disconnecting){
          int xb = srcNode.getXPt(srcPort);
          int xe = vj_c.getXPt(vj_p);
          int yb = srcNode.getYPt(srcPort);
          int ye = vj_c.getYPt(vj_p);
          if(xb < xe) {
            if(yb < ye)
              g.clearRect( xb-2, yb-2, xe - xb+4, ye - yb+4 );
            else
              g.clearRect( xb-2, ye-2, xe - xb+4, yb - ye+4 );
          } else {
            if(yb < ye)
              g.clearRect( xe-2, yb-2, xb - xe+4, ye - yb+4 );
            else
              g.clearRect( xe-2, ye-2, xb - xe+4, yb - ye+4 );
          }
          vj_c.setConnectingNode(vj_p,current_node);
          vj_c.setConnectingPort(vj_p,current_port);
          vj_c.setToDraw(vj_p,true);
          current_node.setConnectingNode(current_port,vj_c);
          current_node.setConnectingPort(current_port,vj_p);
          current_node.setXPt(current_port,xend);
          current_node.setYPt(current_port,yend);
          current_node.resetToDraw(current_port);
          vj_c.connecting(vj_p);
          current_node.connecting(current_port);
          srcNode.disconnecting(srcPort);
          srcNode.resetToDraw(srcPort);
          srcNode.setConnectingNode(srcPort,null);
          srcNode.setConnectingPort(srcPort,0);
          srcNode.setXPt(srcPort,0);
          srcNode.setYPt(srcPort,0);
          disconnecting = false;
          g.drawLine(xbeg, ybeg, xend ,yend);
          return;
        }
        srcNode.setConnectingNode(srcPort,current_node);
```

```
        srcNode.setConnectingPort(srcPort,current_port);
        srcNode.setXPt(srcPort,xbeg);
        srcNode.setYPt(srcPort,ybeg);
        srcNode.setToDraw(srcPort,true);
        current_node.setConnectingNode(current_port,srcNode);
        current_node.setConnectingPort(current_port,srcPort);
        current_node.setXPt(current_port,xend);
        current_node.setYPt(current_port,yend);
        current_node.connecting(current_port);
        srcNode.connecting(srcPort);
        g.drawLine(xbeg, ybeg, xend ,yend);
      }

    }
    public void doAllConnects(){
    }
    public boolean compatible(VJNode sn, int sp, VJNode dn, int dp){
      if(disconnecting){
        VJNode cn_s = sn.getConnectingNode(sp);
        int cp_s = sn.getConnectingPort(sp);
        if(cn_s.getPortType(cp_s)==VJPort.Input && dn.getPortType(dp)==
    VJPort.Input)
          return false;
        if(cn_s.getPortType(cp_s)==VJPort.Output && dn.getPortType(dp)==
    VJPort.Output)
          return false;
      } else {
        if(sn.getPortType(sp)==VJPort.Input && dn.getPortType(dp)==
    VJPort.Input)
          return false;
        if(sn.getPortType(sp)==VJPort.Output && dn.getPortType(dp)==
    VJPort.Output)
          return false;
      }
      if(sn==dn && sp==dp ) return false;
      if(isConnected(dn,dp)) return false;
      return true;
    }

    public boolean isConnected(VJNode node,int port){
      return node.getConnectingNode(port)!=null;
    }
    public void beginMarquee(int x, int y){
      //System.out.println("BEGIN MARQUEE");
      marquee = true;
      xbeg = x ;
      ybeg = y ;
```

```
    xend = x ;
    yend = y ;
    marquee = true;
    Graphics g = getGraphics();
    g.setXORMode(Color.white);
    g.drawRect( xbeg, ybeg, 0, 0 );
  }
  public void doMarquee(int x, int y){
    //System.out.println("DO MARQUEE");
    Graphics g = getGraphics();
    g.setXORMode(Color.white);
    if(xbeg < xend) {
      if(ybeg < yend)
        g.drawRect( xbeg, ybeg, xend - xbeg, yend - ybeg );
      else
        g.drawRect( xbeg, yend, xend - xbeg, ybeg - yend );
    } else {
      if(ybeg < yend)
        g.drawRect( xend, ybeg, xbeg - xend, yend - ybeg );
      else
        g.drawRect( xend, yend, xbeg - xend, ybeg - yend );
    }
    xend = x ;
    yend = y ;
    if(xbeg < xend) {
      if(ybeg < yend)
        g.drawRect( xbeg, ybeg, xend - xbeg, yend - ybeg );
      else
        g.drawRect( xbeg, yend, xend - xbeg, ybeg - yend );
    } else {
      if(ybeg < yend)
        g.drawRect( xend, ybeg, xbeg - xend, yend - ybeg );
      else
        g.drawRect( xend, yend, xbeg - xend, ybeg - yend );
    }
  }
  public void endMarquee(int x, int y){
    int j,i,t,l,b,r;
    boolean emptySelect;
    //System.out.println("END MARQUEE");
    Graphics g = getGraphics();
    g.setXORMode(Color.white);
    if(xbeg < xend){
      if(ybeg < yend)
        g.drawRect( xbeg, ybeg, xend - xbeg, yend - ybeg );
      else
        g.drawRect( xbeg, yend, xend - xbeg, ybeg - yend );
```

```
    } else {
      if(ybeg < yend)
        g.drawRect( xend, ybeg, xbeg - xend, yend - ybeg );
      else
        g.drawRect( xend, yend, xbeg - xend, ybeg - yend );
    }
    xend = x ;
    yend = y ;
    marquee = false;
    emptySelect = true;
    if(xbeg < x && ybeg < y) {
      t = ybeg;
      l = xbeg;
      b = y;
      r = x;
    }
    else
      if(xbeg < x && ybeg > y) {
        t = y;
        l = xbeg;
        b = ybeg;
        r = x;
      }
      else
        if(xbeg > x && ybeg < y) {
          t = ybeg;
          l = x;
          b = y;
          r = xbeg;
        }
        else {
          t = y;
          l = x;
          b = ybeg;
          r = xbeg;
        }
      Rectangle r1 = new Rectangle(l,t,r-l,b-t);
      for(Enumeration e = container.nodes.elements() ;
    e.hasMoreElements() ;) {
        VJNode vjn = (VJNode) e.nextElement();
        if(vjn.nodeRect.intersects(r1)){
          if(vjn.getSelected()) {
            vjn.setSelected(false); // set current selection here
            if(vjn.isUINode)

    app.theDocument.clearLite(app.theDocument.getGraphics(),vjn.comp.
    bounds());
```

```
            }
            else
             vjn.setSelected(true);
             emptySelect = false;
        }
      }
      app.theDocument.repaint();
      //if(emptySelect) container.resetSelected();
      repaint();
  }
  public void beginDrag(int x, int y){
      //System.out.println("BEGIN DRAG");
      xbeg = x ;
      ybeg = y ;
      xend = x ;
      yend = y ;
      Graphics g = getGraphics();
      g.setXORMode(Color.white);
      for(Enumeration e = container.nodes.elements() ;
  e.hasMoreElements() ;) {
          VJNode vjn = (VJNode) e.nextElement();
          if(vjn.getSelected()) {
            g.drawRect(vjn.nodeRect.x,vjn.nodeRect.y,
                    vjn.nodeRect.width,vjn.nodeRect.height);
            drag = true;
          }
      }
  }
  public void doDrag(int x, int y){
      //System.out.println("DO DRAG");
      Graphics g = getGraphics();
      g.setXORMode(Color.white);
      for(Enumeration e = container.nodes.elements() ;
  e.hasMoreElements() ;) {
          VJNode vjn = (VJNode) e.nextElement();
          if(vjn.getSelected())
            g.drawRect(vjn.nodeRect.x+xend-xbeg,vjn.nodeRect.y+yend-
  ybeg,
                    vjn.nodeRect.width,vjn.nodeRect.height);
      }
      xend = x ;
      yend = y ;
      for(Enumeration e = container.nodes.elements() ;
  e.hasMoreElements() ;) {
          VJNode vjn = (VJNode) e.nextElement();
          if(vjn.getSelected())
```

```
        g.drawRect(vjn.nodeRect.x+xend-xbeg,vjn.nodeRect.y+yend-
ybeg,
                vjn.nodeRect.width,vjn.nodeRect.height);
    }
}
public void endDrag(int x, int y){
    int i;
    //System.out.println("END DRAG");
    Graphics g = getGraphics();
    g.setXORMode(Color.white);
    for(Enumeration e = container.nodes.elements() ;
e.hasMoreElements() ;) {
        VJNode vjn = (VJNode) e.nextElement();
        if(vjn.getSelected())
          g.drawRect(vjn.nodeRect.x+xend-xbeg,vjn.nodeRect.y+yend-
ybeg,
                vjn.nodeRect.width,vjn.nodeRect.height);
    }
    g.clearRect(0,60,bounds().width,bounds().height-60); // Clear
Everthing
    for(Enumeration e = container.nodes.elements() ;
e.hasMoreElements() ;) {
        VJNode vjn = (VJNode) e.nextElement();
        if(vjn.getSelected()){
          if(y>60+inset_v){
              vjn.nodeRect.move(vjn.nodeRect.x+xend-
xbeg,vjn.nodeRect.y+yend-ybeg);
              vjn.x = vjn.x +xend-xbeg;
              vjn.y = vjn.y +yend-ybeg;
              for(int j=0;j<vjn.getNumberOfPorts();j++)
                if(vjn.getXPt(j)>=0){
                    vjn.setXPt(j, vjn.getXPt(j)+xend-xbeg);
                    vjn.setYPt(j, vjn.getYPt(j)+yend-ybeg);
                }
          }
        }
    }
    xend = x ;
    yend = y ;
    drag = false;
}
public void clearArea(Rectangle r){
    Graphics g = getGraphics();
    g.clearRect(r.x-9,r.y-9,r.width+24,r.height+24);
    repaint(r.x-9,r.y-9,r.width+24,r.height+24);
}
    public void highlight(Graphics g) {
```

```
        int i;
    }
     public void drawLite(Graphics g, Rectangle r) {
    }
     public void clearLite(Graphics g, Rectangle r) {
    }
      public void resetSelected() {
    }
      public void  update(Graphics g){
          paint(g);
      }
      public void drawNode(Image img,int x, int y){
          Graphics g = getGraphics();
          g.drawImage(img,x,y,this);
      }
      public void paint(Graphics g) {
          int i,j;
          if(firstTime) {
            if(app.isMicrosoft){
              inset_v = 0;
              inset_h = 0;
            } else {
              inset_v = insets().top;
              inset_h = insets().left;
            }
            firstTime = false;
          }
    g.drawLine(0,60+inset_v,bounds().width,60+inset_v);
          container.drawNet(g);
      }
    public boolean handleEvent(Event e) {
           if(app.loading) { System.out.println("Loading VJ"); return true; }
         switch (e.id) {
          case Event.MOUSE_MOVE:
              current_node = onNode(e.x,e.y);
              if(current_node!=null&&!nodeInfoDrawn) {
                EraseNodeInfo();
                DrawNodeInfo();
                nodeInfoDrawn = true;
              } else
                    if(current_node==null&&nodeInfoDrawn) {
                  EraseNodeInfo();
                  nodeInfoDrawn = false;
                }
              current_node = onPort(e.x,e.y);
              if(current_port>=0&&!portInfoDrawn) {
                ErasePortInfo();
```

```
        DrawPortInfo();
        portInfoDrawn = true;
        portInfo = current_port;
      } else
            if(portInfoDrawn&&current_port!=portInfo) {
        ErasePortInfo();
        portInfoDrawn = false;
      }
    return true;
  case Event.KEY_PRESS :
    if(e.key==127) container.theDesktop.doCut();
    if(e.key==4) container.DUMP();
    if(e.controlDown()){
      switch(e.key){
          case 3:
                container.theDesktop.doCopy();
                break;
          case 5:
                container.theDesktop.editComponent();
                break;
          case 24:
                container.theDesktop.doCut();
                break;
          case 22:
                container.theDesktop.doPaste();
                break;
          case 1:
                container.theDesktop.doSelectAll();
                break;
          default:
                break;
      }
    }
    return true;
  case Event.MOUSE_DOWN:
      if((e.when - lastTime)<1000) {
        lastTime = e.when;
        System.out.println("DC");
        container.editComponent();
            return false;
      }
      lastTime = e.when;
      current_node = onNode(e.x,e.y);
      if(current_node!=null){
        doNodeSelection(current_node,e.controlDown(),e.x,e.y);
      } else {
        current_node = onPort(e.x,e.y);
```

```
                if(current_node!=null){
                  if(isConnected(current_node,current_port)) {
                          //System.out.println("BEGIN DISCONNECTING");
                    disconnecting=true;
                  }
                  connecting=true;
                } else {
                  if(!(e.controlDown())){

app.theDocument.clearlight(app.theDocument.getGraphics());
                    container.resetSelected();
                  }
                          current_comp_node =
container.theDesktop.tools.getCurrent();

//System.out.println("current_selection"+current_comp_node);
                  if(current_comp_node>0) {
                    // Add New component
                    VJNode theNode=null;
                    switch(current_comp_node){
                        case 1: VJContainer vjcnt = new VJContainer(app);
                                vjcnt.setParent(container);
                                vjcnt.VJContainerInit(e.x,e.y);
                                theNode = vjcnt;
                                break;
                      //   case 2: VJNetPin vjnp = new VJNetPin(app);
                      //           vjnp.setContainer(container);
                      //           vjnp.VJNetPinInit(e.x,e.y);
                      //           theNode = vjnp;
                      //           break;
                        case 2: VJPlus vjp = new VJPlus(app);
                                vjp.VJPlusInit(e.x,e.y);
                                theNode = vjp;
                                break;
                        case 3: VJBiCopy vjb = new VJBiCopy(app);
                                vjb.VJBiCopyInit(e.x,e.y);
                                theNode = vjb;
                                break;
                        case 4: VJEquals vje = new VJEquals(app);
                                vje.VJEqualsInit(e.x,e.y);
                                theNode = vje;
                                break;
                        case 5: VJConstant vjc = new VJConstant(app);
                                vjc.VJConstantInit(e.x,e.y);
                                theNode = vjc;
                                break;
                        case 6: VJRandom vjr = new VJRandom(app);
```

```
                    vjr.VJRandomInit(e.x,e.y);
                    theNode = vjr;
                    break;
                case 7: VJCounter vjct = new VJCounter(app);
                    vjct.VJCounterInit(e.x,e.y);
                    theNode = vjct;
                    break;
                case 8: VJURLOpener vju = new VJURLOpener(app);
                    vju.VJURLOpenerInit(e.x,e.y);
                    theNode = vju;
                    break;
                case 9: VJSplit vjs = new VJSplit(app);
                    vjs.VJSplitInit(e.x,e.y);
                    theNode = vjs;
                    break;
                case 10: theNode = null;
                    break;
              }
              if(theNode!=null){
                theNode.init();
                theNode.propertiesEditor();
                if(!e.controlDown()){
                  container.resetSelected();
                }
                container.addNode((Object)theNode);
                theNode.setSelected(true);
                        container.theDesktop.tools.setCurrent(0);
                current_comp_node =
container.theDesktop.tools.getCurrent();
                        container.theDesktop.tools.repaint();
              }
             }
            }
            if(connecting) {
              beginConnection(e.x,e.y);
            }
            else beginMarquee(e.x,e.y);
           }
           return true;
      case Event.MOUSE_UP:
           //System.out.println("UP");
           if(connecting) { endConnection(e.x,e.y); repaint(); return
true;}
           if(marquee) { endMarquee(e.x,e.y); repaint(); return true;}
           if(drag) { endDrag(e.x,e.y); repaint(); return true;}
           return true;
      case Event.MOUSE_DRAG:
```

```
                //System.out.println("DRAG");
                if(connecting) {
                  doConnection(e.x,e.y);
                  return true;
                }
                if(marquee) {
                  doMarquee(e.x,e.y);
                  return true;
                }
                if(drag) {
                  doDrag(e.x,e.y);
                  return true;
                }
                return true;
            default: //System.out.println("Other event "+e.toString());
                return false;
          }
        }

    void DrawPortInfo(){
        Graphics g = getGraphics();
        VJNode vjn;
        if(current_node==null || current_port<0) return;
        g.drawString(current_node.name+" Pin:"+current_port+"
    "+current_node.getPortInfo(current_port),30,40);
    }
    void ErasePortInfo(){
        Graphics g = getGraphics();
        g.clearRect(30,29,bounds().width,15);
    }
    void DrawNodeInfo(){
        Graphics g = getGraphics();
        if(current_node == null) return;

    g.drawString(current_node.name+":"+current_node.getNodeInfo(),30,2
    2);
    }
    void EraseNodeInfo(){
        Graphics g = getGraphics();
        g.clearRect(30,12,bounds().width,13);
    }
    void Error(String error) {
        System.out.println("Node: " + error);
        System.out.flush();
    }
    }
```

VJNode is coded as follows:

```
import java.awt.*;
import java.awt.image.*;
import java.util.*;
// A class that is used to represent both primitive and hierarchical VJ
nodes
abstract class VJNode extends VJCore {
// Class attributes
private final static String getPortNameError = "get port name error";
private final static String getPortInfoError = "get port info error";
private final static String noQuickInfo      = "no quick info available";
private final static String noAuthorInfo     = "no author info available";
private final static String noExpirationDate = "no expiration date";
private final static String noVersionInfo    = "no version info";
private final static String noCostInfo       = "no cost info";
private final static String noName           = "no name";
private final static String noComponentURL   = "no URL";
private final static String noPortName       = "no port name";
//Attributes
private String info_url;
private String quick_info;
private String author_info;
private String version_info;
private String cost_info;
private String expiration_date;
private String componentURL;
private Vector port_name;
private Vector port_info;
private Vector port_type;
private Vector port_location;
private Vector XPts;
private Vector YPts;
private int numberOfPorts=0;
private Image normalImage=null;
private Image selectedImage=null;
private String normal = null;
private String selected = null;
private GIFFactory factory=null;
boolean isContainer;          // true if the node is hierarchical
boolean isSelected;           // true if the node is currently selected
boolean isUINode;             // true if the node has a user interface
(exits on the web page)
int x;                        // the x position in the parent container
int y;                        // the y position in the parent container
Vector drawFromPort;
int portCount;                // the number of ports the node has
VJ vj;                        // a reference to the VJ applet
```

```
Rectangle nodeRect;          // the rectangle accociated with this nodes
image
String name;
public VJNode(VJ v){
  super(v);
  vj = v;
  port_name = new Vector();
  port_type = new Vector();
  port_info = new Vector();
  port_location = new Vector();
  drawFromPort   = new Vector();
  XPts   = new Vector();
  YPts   = new Vector();
}
public void VJNodeInit(boolean isCnt,int x,int y,boolean ui){
  this.x = x;
  this.y = y;
  isSelected = false;
  isContainer = isCnt;
  isUINode = ui;
  portCount = 0;
}
public void setSelected(boolean b){
  isSelected = b;
}
public boolean getSelected() {
  return isSelected;
}
public void setImages(Image ni, Image si){
  normalImage = ni;
  selectedImage = si;
}
public void setToDraw(int thePort,boolean b) {
  try {
    drawFromPort.setElementAt(new Boolean(b),thePort);
  } catch(Exception e){
    System.out.println(e);
  }
}
public boolean getToDraw(int port) {
  try {
    return ((Boolean) drawFromPort.elementAt(port)).booleanValue();
  } catch(Exception e){
    System.out.println(e);
    return false;
  }
}
```

```
public void resetToDraw(int thePort) {
  try {
    drawFromPort.setElementAt(new Boolean(false),thePort);
  } catch(Exception e){
    System.out.println(e);
  }
}
public int getXPt(int port) {
  try {
    return ((Integer) XPts.elementAt(port)).intValue();
  } catch(Exception e){
    System.out.println(e);
    return -1;
  }
}
public void setXPt(int port,int val) {
  try {
    XPts.setElementAt(new Integer(val),port);
  } catch(Exception e){
    System.out.println(e);
  }
}
public int getYPt(int port) {
  try {
    return ((Integer) YPts.elementAt(port)).intValue();
  } catch(Exception e){
    System.out.println(e);
    return -1;
  }
}
public void setYPt(int port,int val) {
  try {
    YPts.setElementAt(new Integer(val),port);
  } catch(Exception e){
    System.out.println(e);
  }
}

public void addPort(String pi, String pn, int pt, int pl){
  port_name.addElement(pn);
  port_info.addElement(pi);
  port_type.addElement(new Integer(pt));
  port_location.addElement(new Integer(pl));
  XPts.addElement(new Integer(0));
  YPts.addElement(new Integer(0));
  connectingNode.addElement(null);
  connectingPort.addElement(new Integer(0));
```

-60-

```
    drawFromPort.addElement(new Boolean(false));
  };
  public String getPortInfo(int port){
    try {
      return (String) port_info.elementAt(port);
    } catch(Exception e){
      System.out.println(e);
      return getPortInfoError;
    }
  };
  public String getNodeInfo(){
    if(quick_info==null) return noQuickInfo;
    return quick_info;
  };
  public void setComponentInfo(String n){
    quick_info=n;
  };
  public Component getComponent(){
    if(comp==null) System.out.println("The component "+name+" is
null");
    return comp;
  };
  public void setComponent(Component n){
    comp=n;
  };
  public String getAuthorName(){
    if(author_info==null) return noAuthorInfo;
    return author_info;
  };
  public void setAuthorName(String n){
    author_info=n;
  };
  public String getExpirationDate(){
    if(expiration_date==null) return noExpirationDate;
    return expiration_date;
  };
  public void setExpirationDate(String n){
    expiration_date=n;
  };
  public String getCost(){
    if(cost_info==null) return noCostInfo;
    return cost_info;
  };
  public void setCost(String n){
    cost_info = n;
  };
  public String getVersion(){
```

```
    if(version_info==null) return noVersionInfo;
    return version_info;
  };
  public void setVersion(String n){
    version_info = n;
  };
  public void setName(String n){
    name = n;
  };
  public String getName(){
    if(name==null) return noName;
    return name;
  };
  public void setComponentURL(String n){
    componentURL = n;
  };
  public String getComponentURL(){
    if(componentURL==null) return noComponentURL;
    return componentURL;
  };
  public void setNormalIcon(String n){
    normal = n;
  };
  public Image getNormalIcon() { return normalImage; }
  public void setSelectedIcon(String n){
    selected = n;
  };
  public Image getSelectedIcon(){ return selectedImage; };
  private boolean inRange(int n) {
    return n >=0 && n < port_type.size();
  }

  public int getNumberOfPorts(){
    return port_type.size();
  }
  public void setNumberOfPorts(int n){
    numberOfPorts = n;
  }
  public int getPortType(int port){
    try {
      return ((Integer) port_type.elementAt(port)).intValue();
    } catch(Exception e){
      System.out.println(e);
      return -1;
    }
  }
  public int getPortLocation(int port){
```

```
    try {
      return ((Integer) port_location.elementAt(port)).intValue();
    } catch(Exception e){
      System.out.println(e);
      return -1;
    }
  }
  public String getPortName(int port){
    try {
      return (String) port_name.elementAt(port);
    } catch(Exception e){
      System.out.println(e);
      return noPortName;
    }
  }
  abstract VJNode dup();
  abstract void   disconnecting(int port);
  abstract void   connecting(int port);
  abstract void   load(String s);
  abstract String save();
  abstract void   propertiesEditor() ;
  }
```

VJ Tool dispatches start stop and init messages to all active instances of components as start(), stop() and init(). When VJ is loading, we want to have the user wait until that process is completed, so VJ Tool will ignore events and a splash sheet with a warning message is displayed that says no action will be possible until loading is completed. Once VJ Tool is loaded and initialized completely, the warning screen is dropped and user interaction is enabled.

The initialization process initializes and enables the logical view and the physical view. The initialization processing includes VJ Tool's data structures and palettes, which comprise "primitive" or basic building block components coded entirely in Java. Once initialization is completed, the cut, paste, select all, move, drag, drop, point, and other functions are active. These functions associated with the VJ Tool menu bars are defaulted from the VJContainer class. The palettes and menus are created from VJDesktop.

VJ Tool then invokes user requests and such actions as may be appropriate thereto, as indicated in block **312**. Once all requests have been satisfied, VJ Tool cycles back through link **314** and waits for subsequent user requests. If there are no further requests to be carried out, the user exits via block **316**.

FIG. **4**A shows an example of a World Wide Web home page that is displayed when the Netscape Navigator is invoked in accordance with a preferred embodiment. If this page had included a Java enabled applet, that applet would have been downloaded and activated as soon as the user clicked on it. Alternatively, an applet could be locally resident and thus be directly available. FIG. **4**B illustrates the same web page with its main pull-down menu activated. FIG. **4**C depicts the "Open File" pull-down menu of the home page shown in FIG. **4**B. Note that the files found in the local file "saul.htm" include the applet called "DemoRelease", which is actually a back level version of VJ Tool, ready to select and run.

FIG. **4**D shows the VJ Tool applet after it has been initialized and is ready to run. VJ Tool comes up on the user's screen after being initialized and deployed with two main views as shown in FIG. **4**D. These views are equivalent to the status depicted by block **310** in FIG. **3**. Window **402** shows the active VJ Tool desktop, in particular, its logical view **402**. Logical view **402**, also called the document view, is created from VJDocument. Window segment **404** is the right hand portion of the base home page shown in FIGS. **4**A, **4**B and **4**C. The other view, the user physical view is shown in FIG. **5**.

The source code enabling VJDocument is presented below.

```
import java.util.*;
import java.awt.*;
```

```
class VJDocument extends container {
  VJ app;
  VJContainer container;
  VJNode current_i;
  int current_ui_comp;
  static int xOffset = 40;    // used to define the position on the desktop
  static int yOffset = 100;   // at which the new icon corresponding to a
                              // component is to be placed.
  int top,left,right,bottom;
  int ytop,xleft,xright,ybottom;
  boolean grow;
  int growType;
  public VJDocument(VJ v,VJContainer c){
    // Set the environment variables
    super(v);
    app = v;
    container = c;
    current_ui_comp = 0;
    current_i = null;
    // Initial Layout for the Applet
    setLayout(null);
  }
 void marqueeAction(boolean cntrDwn,Rectangle r,int x,int y){
  current_ui_comp = app.uiTools.getCurrent();
  if(current_ui_comp>0 && bigEnough()) {
    Graphics g = getGraphics();
    VJNode vjn = newComponent(cntrDwn,x,y);
    if(vjn!=null){;
      if(!cntrDwn) clearlight(g);
      current_ui_comp = 0;
      vjn.setSelected(true);
      container.theDesktop.vp_w.repaint();
      drawLite(g,r);
      app.uiTools.setCurrent(0);
      app.uiTools.repaint();
    }
    return;
  }
  boolean emptySelect;
  emptySelect = true;
  for(Enumeration e = app.theContainer.nodes.elements();
e.hasMoreElements() ;) {
    VJNode vjn = (VJNode) e.nextElement();
    if(vjn.isUINode&&vjn.comp.bounds().intersects(r)){
      if(cntrDwn){
        if(vjn.getSelected()){
          vjn.setSelected(false);
```

-65-

```
            clearLite(getGraphics(),vjn.comp.bounds());
          }else vjn.setSelected(true);
        }
        else
          vjn.setSelected(true);
        emptySelect = false;
        }
    }
    if(!emptySelect){
      repaint();
      container.theDesktop.vp_w.repaint();
    }
  }
  void drawDrag(Graphics g,int i,int j,int k,int l){
    for(Enumeration e = app.theContainer.nodes.elements();
  e.hasMoreElements();) {
      VJNode vjn = (VJNode) e.nextElement();
      if(vjn.getSelected())
        g.drawRect(vjn.comp.bounds().x-1+xend-
  xbeg,vjn.comp.bounds().y-1+yend-ybeg,

  vjn.comp.bounds().width+1,vjn.comp.bounds().height+1);
    }
  }
  void eraseDrag(Graphics g,int i,int j,int k,int l){
    for(Enumeration e = app.theContainer.nodes.elements();
  e.hasMoreElements();) {
      VJNode vjn = (VJNode) e.nextElement();
      if(vjn.getSelected()) g.drawRect(vjn.comp.bounds().x-1+xend-
  xbeg,vjn.comp.bounds().y-1+yend-ybeg,

  vjn.comp.bounds().width+1,vjn.comp.bounds().height+1);
    }
  }
  void endDragAction(Graphics g,int i,int j,int k,int l){
    for(Enumeration e = app.theContainer.nodes.elements();
  e.hasMoreElements();) {
      VJNode vjn = (VJNode) e.nextElement();
      if(vjn.getSelected()){
        clearLite(g, vjn.comp.bounds());
        vjn.comp.move(vjn.comp.bounds().x+xend-
  xbeg,vjn.comp.bounds().y+yend-ybeg);
      }
    }
  }
  void containerPaint(Graphics g){
  }
```

```
void containerMouseMove(Evente){
}
void containerKeyPress(Evente){
  if(e.key==127) app.theContainer.doCut();
  if(e.key==4) container.DUMP();
   if(e.controlDown()){
     switch(e.key){
          case 3: System.out.println("copy");
                  app.theContainer.doCopy();
                  break;
          case 24: System.out.println("cut");
                   app.theContainer.doCut();
                   break;
          case 22: System.out.println("paste");
                   app.theContainer.doPaste();
                   break;
          case 1: System.out.println("all");
                  app.theContainer.doSelectAll();
                  break;
          default:  System.out.println("key"+e.key);
                  break;
     }
  }
}

void containerMouseDown(Evente){
  }
void containerMouseUp(Evente){
  if(grow) endGrow(e.x,e.y);
}

void containerMouseDrag(Evente){
  if(grow) doGrow(e.x, e.y);
}

void containerDoubleClick(){

}
boolean mouseDownSelects(Evente) { return true; }
boolean mouseDownSelection(Evente){
   VJNode vjn = onUIComponent(e.x,e.y);
   if(vjn==null){
     if(!e.controlDown()) clearlight(getGraphics());
     System.out.println("Noton a UI Copmponent");
     return false;
   }
```

```
    doUISelection(current_i,e.controlDown(),e.x,e.y);
    return true;
  }
  void mouseDownReset(Event e){
    clearlight(getGraphics());
  }
  boolean doMarquee() { return true; }
  public VJNode onUIComponent(int x, int y){
    for(Enumeration e = app.theContainer.nodes.elements();
  e.hasMoreElements() ;) {
      VJNode vjn = (VJNode) e.nextElement();
      if(vjn.isUINode){
        Rectangle r = vjn.comp.bounds();
        r.x = r.x-4;
        r.y = r.y-4;
        r.width = r.width+8;
        r.height = r.height+8;
        if(r.inside(x,y)){
          current_i = vjn;
          return vjn;
        }
      }
    }
    return null;
  }
  public boolean closeEnough(int fx, int fy,int x, int y,int epsilon){
  return x <fx+epsilon && x >fx-epsilon && y <fy+epsilon && y >fy-
  epsilon;
  }

  public int getGrowType(VJNode vjn, int x, int y){
  int top_y, mid_y, bottom_y,left_x, mid_x,right_x;
  Rectangle r = vjn.comp.bounds();
  top_y    = r.y-4;
  mid_y    = r.y+(r.height+1)/2;
  bottom_y = r.y+r.height+4;
  left_x   = r.x-4;
  mid_x    = r.x+(r.width+1)/2;
  right_x  = r.x+r.width+4;
  if(closeEnough(left_x,top_y,   x,y,4)) return 0;
  if(closeEnough(mid_x ,top_y,   x,y,4)) return 1;
  if(closeEnough(right_x,top_y,  x,y,4)) return 2;
  if(closeEnough(left_x,mid_y,   x,y,4)) return 3;
  if(closeEnough(right_x,mid_y,  x,y,4)) return 4;
  if(closeEnough(left_x,bottom_y,x,y,4)) return 5;
  if(closeEnough(mid_x ,bottom_y,x,y,4)) return 6;
  if(closeEnough(right_x,bottom_y,x,y,4))return 7;
```

```
return 8;
}
public void doUISelection(VJNode vjn,boolean cntDwn,int x, int y){
   growType = getGrowType(vjn,x,y);
   System.out.println("Do UI "+growType);
   if(!cntDwn){
     if(!vjn.getSelected()){
       resetSelected();
       vjn.setSelected(true);
     }
     if(growType==8)
       beginDrag(x,y);
     else
       beginGrow(vjn,x,y);
     //current_component = i;
     repaint();
     container.theDesktop.vp_w.repaint();
   } else {
     if(vjn.getSelected()){
       Rectangle r = vjn.comp.bounds();
       vjn.setSelected(false);
       clearLite(getGraphics(),r);
       for(Enumeration e = app.theContainer.nodes.elements();
e.hasMoreElements();) {
         VJNode vjn1 = (VJNode) e.nextElement();
             if(vjn1.getSelected()){
           repaint();
         return;
             }
       }
       } else {
       vjn.setSelected(true);
       container.theDesktop.vp_w.repaint();
       repaint();
       return;
     }
   }
}
    public boolean bigEnough(){
      //return xbeg-yend !=0 && ybeg-xbeg!=0;
      return true;
    }
public void beginGrow(VJNode vjn, int x, int y){
  Rectangle r = vjn.comp.bounds();
  xbeg = x ;
  ybeg = y ;
  xend = x ;
```

-69-

```
        yend = y ;
        grow = true;
        Graphics g = getGraphics();
        g.setXORMode(Color.white);
        top = r.y; ytop=top;
        left = r.x; xleft=left;
        bottom = r.y+vjn.comp.bounds().height;ybottom=bottom;
        right = r.x+vjn.comp.bounds().width;xright = right;
        g.drawRect( left, top, r.width, r.height );
    }
    public void doGrow(int x, int y){
        Graphics g = getGraphics();
        g.setXORMode(Color.white);
        g.drawRect(left, top, right-left ,bottom-top);
        xend = x ;
        yend = y ;
        switch(growType){
            case 0: // top left
                top = ytop+(yend-ybeg);
                left = xleft+(xend-xbeg);
                break;
            case 1: // top middle
                top = ytop+(yend-ybeg);
                break;
            case 2: // top right
                top = ytop+(yend-ybeg);
                right = xright+(xend-xbeg);
                break;
            case 3: // middle left
                left = xleft+(xend-xbeg);
                break;
            case 4: // middle right
                right = xright+(xend-xbeg);
                break;
            case 5: // bottom left
                left = xleft+(xend-xbeg);
                bottom = ybottom+(yend-ybeg);
                break;
            case 6: // bottom middle
                bottom = ybottom+(yend-ybeg);
                break;
            case 7: // bottom right
                right = xright+(xend-xbeg);
                bottom = ybottom+(yend-ybeg);
                break;
        }
        g.drawRect(left, top, right-left ,bottom-top);
```

```
}
public void endGrow(int x, int y){
  Graphics g = getGraphics();
  g.setXORMode(Color.white);
  g.drawRect(left, top, right-left ,bottom-top);
  xend = x ;
  yend = y ;
  clearLite(g, current_i.comp.bounds());
  current_i.comp.reshape(left,top, right-left ,bottom-top);
  //if(current_i.comp instanceof VJChart)
((VJChart)(current_i.comp)).doResize(left,top, right-left ,bottom-top);
  drawLite(g, current_i.comp.bounds());
  grow = false;
}
public void clearlight(Graphics g) {
  for(Enumeration e = app.theContainer.nodes.elements();
e.hasMoreElements() ;) {
        VJNode vjn = (VJNode) e.nextElement();
        if(vjn.getSelected()&&vjn.isUINode){
          clearLite( g,vjn.comp.bounds());
          vjn.setSelected(false);
           }
     }
  container.theDesktop.vp_w.repaint();
}
public void highlight(Graphics g) {
  for(Enumeration e = app.theContainer.nodes.elements();
e.hasMoreElements() ;) {
        VJNode vjn = (VJNode) e.nextElement();
        if(vjn.getSelected()&&vjn.isUINode){
          drawLite( g,vjn.comp.bounds());
           }
     }
}
public void drawLite(Graphics g, Rectangle r) {
  int top_y, mid_y, bottom_y,left_x, mid_x,right_x;
  top_y = r.y;
  mid_y = r.y+(r.height+1)/2-1;
  bottom_y=r.y+r.height;
  left_x =r.x;
  mid_x =r.x+(r.width+1)/2-1;
  right_x =r.x+r.width;
  g.setColor(Color.red);
  g.fillRect(left_x-4, top_y-4, 4, 4);
  g.fillRect(left_x-4, mid_y-2, 4, 4);
  g.fillRect(left_x-4, bottom_y, 4, 4);
  g.fillRect(right_x, top_y-4, 4, 4);
```

```
    g.fillRect(right_x,  mid_y-2,  4, 4);
    g.fillRect(right_x,  bottom_y, 4, 4);
    g.fillRect(mid_x-2,  top_y-4,  4, 4);
    g.fillRect(mid_x-2,  bottom_y, 4, 4);
  }
  public void clearLite(Graphics g, Rectangle r) {
    int top_y, mid_y, bottom_y,left_x, mid_x,right_x;
    top_y = r.y;
    mid_y = r.y+(r.height+1)/2-1;
    bottom_y=r.y+r.height;
    left_x =r.x;
    mid_x =r.x+(r.width+1)/2-1;
    right_x =r.x+r.width;
    g.clearRect(left_x-4,   top_y-4,   4, 4);
    g.clearRect(left_x-4,   mid_y-2,   4, 4);
    g.clearRect(left_x-4,   bottom_y,  4, 4);
    g.clearRect(right_x,    top_y-4,   4, 4);
    g.clearRect(right_x,    mid_y-2,   4, 4);
    g.clearRect(right_x,    bottom_y,  4, 4);
    g.clearRect(mid_x-2,    top_y-4,   4, 4);
    g.clearRect(mid_x-2,    bottom_y,  4, 4);
  }
  public void resetSelected() {
  }

  public  synchronized VJNode newComponent(boolean cntrDwn,int x,
  int y){
     int j,i,t,l,b,r;
     if(xbeg < x && ybeg < y) {
       t = ybeg;
       l = xbeg;
       b = y;
       r = x;
     } else
       if(xbeg < x && ybeg > y) {
         t = y;
         l = xbeg;
         b = ybeg;
         r = x;
       } else
         if(xbeg > x && ybeg < y) {
           t = ybeg;
           l = x;
           b = y;
           r = xbeg;
         } else {
           t = y;
```

```
        l = x;
        b = ybeg;
        r = xbeg;
      }
if((r-l)<16 || (b-t)<16) {
  return null;
}
 //resetSelected();
 VJNode vjn;
 switch(current_ui_comp){
      case 1:  VJLabel vjl = new VJLabel(app);
               vjl.VJLabelInit(xOffset,yOffset);
               vjn = (VJNode) vjl;
               break;
      case 4:  VJButton vjb = new VJButton(app);
               vjb.VJButtonInit(xOffset,yOffset);
               vjn = (VJNode) vjb;
               break;
      case 5:  VJCheckbox vjcb = new VJCheckbox(app);
               vjcb.VJCheckboxInit(xOffset,yOffset);
               vjn = (VJNode) vjcb;
               break;
      case 6:  VJChoice vjch = new VJChoice(app);
               vjch.VJChoiceInit(xOffset,yOffset);
               vjch.comp.reshape(l,t,r-l,b-t+1);
               vjn = (VJNode) vjch;
               break;
      case 7:  VJList vjli = new VJList(app);
               vjli.VJListInit(xOffset,yOffset);
               vjli.comp.reshape(l,t,r-l,b-t+1);
               vjn = (VJNode) vjli;
               break;
      case 8:  VJHScrollbar vjhsb = new VJHScrollbar(app);
               vjhsb.VJHScrollbarInit(xOffset,yOffset);
               vjn = (VJNode) vjhsb;
               break;
      case 9: VJVScrollbar vjvsb = new VJVScrollbar(app);
               vjvsb.VJVScrollbarInit(xOffset,yOffset);
               vjn = (VJNode) vjvsb;
               break;
      case 10: VJChart vjchart = new VJChart(app);
               vjchart.VJChartInit(xOffset,yOffset);
               vjn = (VJNode) vjchart;
               break;
      case 2:  VJTextField vjt = new VJTextField(app);
               vjt.VJTextFieldInit(xOffset,yOffset);
               vjn = (VJNode) vjt;
```

```
                break;
        case 3:  VJTextArea vjta = new VJTextArea(app);
                vjta.VJTextAreaInit(xOffset,yOffset);
                vjn = (VJNode) vjta;
                break;
        default: System.out.println("UNKNOWNTYPE!"); return null;
      }
      if(!cntrDwn){
        container.theDesktop.vp_w.resetSelected();
      }
      container.addNode((Object)vjn);
      if(yOffset >220) {
        yOffset = 100;
        xOffset = xOffset+60;
      } else yOffset = yOffset+40;
      vjn.comp.move(l,t);
      add(vjn.comp);
      validate();
      vjn.comp.reshape(l,t,r-l,b-t);
      vjn.comp.show();
      vjn.init();
      vjn.propertiesEditor();
      return vjn;
    }
    public void  update(Graphics g){
       paint(g);
    }
    public void paint(Graphics g) {
      highlight(g);

    VJDocument works in conjunction with "container.java." The source
    code for "container.java" appears below.
    import java.util.*;
    import java.awt.*;
    abstract class container extends Panel {
    boolean marquee;
    boolean drag;
    int xbeg,xend,ybeg,yend;
    int inset_h,inset_v;
    boolean firstTime = true;
    static long lastTime=0;
    VJ app;
    public container(VJ v) {
    super();
    setLayout(null);
    app = v;
    marquee = false;
```

```
drag = false;
}
public void beginMarquee(int x, int y){
  //System.out.println("BEGINMARQUEE");
  xbeg = x ;
  ybeg = y ;
  xend = x ;
  yend = y ;
  marquee = true;
  Graphics g = getGraphics();
  g.setXORMode(Color.white);
  g.drawRect( xbeg, ybeg, 0, 0 );
}
public void doMarquee(int x, int y){
  //System.out.println("DOMARQUEE");
  Graphics g = getGraphics();
  g.setXORMode(Color.white);
  if(xbeg < xend) {
    if(ybeg < yend)
      g.drawRect( xbeg, ybeg, xend - xbeg, yend - ybeg );
    else
      g.drawRect( xbeg, yend, xend - xbeg, ybeg - yend );
  } else {
    if(ybeg < yend)
      g.drawRect( xend, ybeg, xbeg - xend, yend - ybeg );
    else
      g.drawRect( xend, yend, xbeg - xend, ybeg - yend );
  }
  xend = x ;
  yend = y ;
  if(xbeg < xend) {
    if(ybeg < yend)
      g.drawRect( xbeg, ybeg, xend - xbeg, yend - ybeg );
    else
      g.drawRect( xbeg, yend, xend - xbeg, ybeg - yend );
  } else {
    if(ybeg < yend)
      g.drawRect( xend, ybeg, xbeg - xend, yend - ybeg );
    else
      g.drawRect( xend, yend, xbeg - xend, ybeg - yend );
  }
}
public void endMarquee(Event e){
  int x = e.x;
  int y = e.y;
  int j,i,t,l,b,r;
  boolean emptySelect;
```

```
//System.out.println("ENDMARQUEE");
Graphics g = getGraphics();
g.setXORMode(Color.white);
if(xbeg < xend){
  if(ybeg < yend)
    g.drawRect( xbeg, ybeg, xend - xbeg, yend - ybeg );
  else
    g.drawRect( xbeg, yend, xend - xbeg, ybeg - yend );
} else {
  if(ybeg < yend)
    g.drawRect( xend, ybeg, xbeg - xend, yend - ybeg );
  else
    g.drawRect( xend, yend, xbeg - xend, ybeg - yend );
}
xend = x ;
yend = y ;
marquee = false;
emptySelect = true;
if(xbeg < x && ybeg < y) {
  t = ybeg;
  l = xbeg;
  b = y;
  r = x;
}
else
  if(xbeg < x && ybeg > y) {
    t = y;
    l = xbeg;
    b = ybeg;
    r = x;
  }
  else
    if(xbeg > x && ybeg < y) {
      t = ybeg;
      l = x;
      b = y;
      r = xbeg;
    }
    else {
      t = y;
      l = x;
      b = ybeg;
      r = xbeg;
    }
Rectangle r1 = new Rectangle(l,t,r-l,b-t);
marqueeAction(e.controlDown(),r1,x,y);
repaint();
```

```
}
public void beginDrag(int x, int y){
  //System.out.println("BEGINDRAG");
  xbeg = x ;
  ybeg = y ;
  xend = x ;
  yend = y ;
  drag = true;
  Graphics g = getGraphics();
  g.setXORMode(Color.white);
  drawDrag(g,x,y,xend,yend);  // if drag begin is valid make drag = true
}
public void doDrag(int x, int y){
  //System.out.println("DODRAG");
  Graphics g = getGraphics();
  g.setXORMode(Color.white);
  eraseDrag(g,x,y,xend,yend);
  xend = x ;
  yend = y ;
  drawDrag(g,x,y,xend,yend);
}
public void endDrag(int x, int y){
  int i;
  //System.out.println("ENDDRAG");
  Graphics g = getGraphics();
  g.setXORMode(Color.white);
  eraseDrag(g,x,y,xend,yend);
  g.clearRect(0,60,bounds().width,bounds().height-60);// Clear
Everthing
  endDragAction(g,x,y,xend,yend);
  xend = x ;
  yend = y ;
  drag = false;
}
public void clearArea(Rectangle r){
  Graphics g = getGraphics();
  g.clearRect(r.x-9,r.y-9,r.width+18,r.height+18);
  repaint(r.x-9,r.y-9,r.width+18,r.height+18);
}
public void  update(Graphics g){
paint(g);
}
public void paint(Graphics g) {
int i,j;
if(firstTime){
  if(app.isMicrosoft){
    inset_v = 0;
```

```
    inset_h = 0;
   } else {
    inset_v = insets().top;
    inset_h = insets().left;
   }
   firstTime = false;
  }
  containerPaint(g);
  }
  public boolean handleEvent(Event e) {
  if(app.loading){ System.out.println("LoadingVJ"); return true; }

  switch(e.id) {
      case Event.MOUSE_MOVE:
          containerMouseMove(e);
          return false;
      case Event.KEY_PRESS:
          containerKeyPress(e);
          return false;
      case Event.MOUSE_DOWN:
          if((e.when - lastTime)<400) {
             containerDoubleClick();
             lastTime = e.when;
                  return false;
          }
          lastTime = e.when;
          if(mouseDownSelects(e)){
             if(mouseDownSelection(e))return false;
          } else {
            if(!(e.controlDown()))mouseDownReset(e);
            containerMouseDown(e);
          }
          if(doMarquee()) beginMarquee(e.x,e.y);
          return false;
      case Event.MOUSE_UP:
          containerMouseUp(e);
          if(marquee){ endMarquee(e); repaint(); return false;}
          if(drag){ endDrag(e.x,e.y); repaint(); return false;}
          return false;
      case Event.MOUSE_DRAG:
          containerMouseDrag(e);
          if(marquee){ doMarquee(e.x,e.y); return false;}
          if(drag){ doDrag(e.x,e.y); return false;}
          return false;
      default: //System.out.println("Otherevent "+e.toString());
          return false;
    }
```

```
}
abstract void marqueeAction(boolean cnrl, Rectangle r,int x, int y);
abstract void drawDrag(Graphics g,int i,int j,int k,int l);
abstract void eraseDrag(Graphics g,int i,int j,int k,int l);
abstract void endDragAction(Graphics g,int i,int j,int k,int l);
abstract void containerPaint(Graphics g);
abstract void containerMouseMove(Evente);
abstract void containerKeyPress(Evente);
abstract void containerMouseDown(Evente);
abstract void containerMouseUp(Evente);
abstract void containerMouseDrag(Evente);
abstract void containerDoubleClick();
abstract boolean mouseDownSelects(Evente);
abstract boolean mouseDownSelection(Evente);
abstract void mouseDownReset(Evente);
abstract boolean doMarquee();
}
```

The palette in logical view **402**, as shown in FIG. **5**, is provided with a series of components that are instantiated from the component VJContainer. FIG. **5** illustrates the physical view or end user view screen portion in accordance with a preferred embodiment of the VJ Tool.

FIG. **5** also shows the physical view **500** of the VJ desktop. The logical view **402** is in the foreground on the right hand side of the drawing, while the physical view **500** is in the background on the left side of the screen. Physical view **500** is provided with palette containers **502** to **530** as follows: **502** is a select cursor button; **504** is a simple AWT label; **506** is a simple AWT text field; **508** is a simple AWT text area; **510** is a simple AWT button; **512** is a simple AWT checkbox; **514** is a simple AWT choice box; **516** is a simple AWT list; **518** is a simple AWT horizontal scroll bar; **520** is a simple AWT vertical scroll bar; **522** is a simple bar chart; **524** is a simple spreadsheet; **526** is a simple AWT panel; **528** is a calendar; and **530** is an animator.

Logical view **402** is provided with palette containers **540** to **572** as follows: **540** is a select cursor button; **542** is a VJ folder or container; **544** is an adder; **546** is a bicopy component. The bicopy component acts as a multiplexor so that whatever is input on one pin of a bicopy element is output on its other pins. **548** is a test for equals; **550** is a constant (e.g. −1 or 3.1457 or "abc"); **552** is a random number generator; **554** is a counter; **556** is an URL opener; **558** is a splitter used to connect input/output pins to components that are either input or output elements; **560** is a two-dimensional grapher; **562** is a three-dimensional grapher; **564** is a delta three-dimensional grapher; **566** is an URL text viewer; **570** forwards input from any one of an element's input pins to an outpin pin thereof; **572** is a calculator; and **574** is a sound player. AWT is the Abstract Windowing Toolkit and contains the objects utilized for providing basic windowing functions in accordance with a preferred embodiment.

The components of logical view **402** and physical view **500** can be dropped, respectively, from their palettes into the view they are associated with. Moving the cursor over any component causes a short description of that component to appear in the logical view.

FIGS. **6** through **17** illustrate an example of a VJ Tool used to quickly, efficiently and accurately create an applet derived mini application that does not require the VJ Tool user to write a single line of code. Unlike other "visual" tools currently available, VJ Tool is a "point and click" and "drag and drop" development environment in which the components are all activate immediately. It is important to note that VJ Tool provides a "live" environment; that is, you can see modifications you make take hold or be applied as the component is utilized. The physical view results in corresponding changes in the logical view. If you eliminate a component from the physical view, it disappears as well from the logical page and if you change the properties of a component in the physical view, its associated component in the logical view reflects that change as it is made. The components initialization method occurs when the component is instantiated and the component immediately communicates with the other components previously defined for the physical and logical display.

The component's "liveness" refers to immediate activation of components as components are interactively added to the environment. The action of the components is analogous to a What You See Is What You Get (WYSIWIG) word processing environment in which immediate feedback of status and value information is available. So, for example, as a button is placed on the display, it is immediately available for connection to a player component to display text or activate a multimedia presentation.

"Liveness" and "live", as used in this description, are terms employed to illustrate how the present invention promotes and permits immediate socialization of new components, as they are instantiated or dropped into either the logical or physical views, with existing components. This is achieved, as depicted in the functional block diagram of FIG. **6**A, by registering the component being instantiated with the VJ Kernel via block **620**. Registration, in turn, invokes an initialization method in block **622** that appropriately personalizes the new component when it executes the logic associated with the initialization method, see block **624**, which can include the provision of an editor for the new component if its properties are to editable. The new component can immediately communicate or socialize with other components previously defined in the logical and physical views as shown by block **626**. Liveness also indicates that the environment is tested as new components are instantiated. This means that immediate connections between components are permitted on the fly. There is no requirement that all possible connections are tried first to insure that nothing blows up. The outcome of this capability is that design creation and trial are integrated so that the results can be observed virtually at the same time that the interconnection of components is made. As noted later herein in connection with the description of FIG. **16**, this is analogous to building a hardware prototype or test board by interconnecting, disconnecting and moving electronic components around the test board while the power is left on. As will be shown by the following example of Fahrenheit and Centigrade conversion, there is immediate feedback of component status and value information. This makes VJ Tool, in essence, a WYSIWIG development environment.

The specific example shown in various stages in FIGS. **6** through **14** depicts two scroll bars that have been adapted through use of VJ Tool to display conversions of Fahrenheit and Centigrade temperatures to each other on a dynamic basis. This applet has been created in the physical view and reflected in the logical view in accordance with a preferred embodiment of the present invention.

FIG. **6** shows the creation of a first scroll slider bar **602** which will be used to indicate Centigrade temperatures. This object has been instantiated by clicking on the vertical scroll bar component **520** and then dragging and dropping the object to its FIG. **6** position in the physical view **500**. When scroll bar **602** is created, its editor, vertical scroll bar editor **604**, pops up as a dialog box wherein the current, visible, maximum and minimum values of the scroll bar just crated are displayed and can be edited. As shown, scroll bar **602** has a current value of fifty, it is showing only ten units of its total range which varies from a maximum of one hundred (boiling point) to a minimum of zero (freezing point).

FIG. **7** is an example of marqueing or sizing the vertical scrollbar in accordance with a preferred embodiment. This is done by using the mouse to drag the edges or handles **606**, see FIG. **6**, of scroll bar **604** until the desired scroll bar shape is achieved. The result of that action is shown in FIG. **7** where the original scroll bar has been lengthened and reduced in width to form scroll bar **604***a*. FIG. **8** illustrates another example of adjusting the size of the vertical scrollbar **604***a* to a shorter, slightly wider, outline **604***b*. The logical view **402** can be seen in FIG. **8**, where it remains in the background, available for use as may be needed.

The source code for the VJScrollbar component is presented below.

```
import java.awt.*;
import java.util.*;
public class VJVScrollbar extends VJNode {
// Attributes of this component
public AWTVScrollbar bar;
static int instanceCount = 0;
vscrollbarEditor edit;
static Image normalImage;
static Image selectedImage;
final static String out = "out_vsb.gif";
final static String in  = "in_vsb.gif";
final static String port0_info  = "for setting/getting minimum value";
final static String port0_name  = "Pin 0";
final static String port1_info  = "for setting/getting maximum value";
final static String port1_name  = "Pin 1";
final static String port2_info  = "for setting/getting the current value";
final static String port2_name  = "Pin 2";
final static String url_name    = "hscrollbar.html";
final static String info_name   = "A simple AWT horizontal scrollbar";
VJ vj;
int send_index0 = -1;
int request_index0 = 0;
int send_index1 = -1;
```

```
int request_index1 = 0;
int send_index2 = -1;
int request_index2 = 0;
// Constructor
public VJVScrollbar(VJ v){
  super(v);
  vj = v;
}
VJNode dup() {
 VJVScrollbar vj_comp = new VJVScrollbar(vj);
 try {
   int i = x+40;
   int j = y+40;
   AWTVScrollbar t = new AWTVScrollbar(vj_comp);
   vj_comp.bar = t;

t.setValues(bar.getValue(),bar.getVisible(),bar.getMinimum(),bar.getMaxi
mum());
   vj_comp.setNormalIcon(out);
   vj_comp.setSelectedIcon(in);
   vj_comp.setName("VScrollbar");
   vj_comp.setComponent((Component)t);
   vj_comp.setComponentURL(url_name);
   vj_comp.setComponentInfo(info_name);
   vj_comp.VJNodeInit(false,i,j,true);

vj_comp.addPort(port0_info,port0_name,VJPort.InputOutput,VJPort.No
rthLeftCenter); // Pin 0

vj_comp.addPort(port1_info,port1_name,VJPort.InputOutput,VJPort.No
rthRightCenter); // Pin 1

vj_comp.addPort(port2_info,port2_name,VJPort.InputOutput,VJPort.So
uthCenter); // Pin 1
   vj_comp.setXPt(0,getXPt(0)+40);
   vj_comp.setYPt(0,getYPt(0)+40);
   vj_comp.setXPt(1,getXPt(1)+40);
   vj_comp.setYPt(1,getYPt(1)+40);
   vj_comp.setXPt(2,getXPt(2)+40);
   vj_comp.setYPt(2,getYPt(2)+40);
   vj_comp.setImages(normalImage,selectedImage); //Pass references
to the static images down to the node
   vj_comp.nodeRect = new Rectangle(i-3,j-
3,selectedImage.getWidth(vj.theContainer.theDesktop.vp_w)+3,selectedI
mage.getHeight(vj.theContainer.theDesktop.vp_w)+3);
   vj_comp.setSelected(true);
   vj.theDocument.add(vj_comp.comp);
```

```
    vj_comp.comp.validate();

vj_comp.comp.reshape(comp.bounds().x+50,comp.bounds().y+50,comp.
bounds().width,comp.bounds().height+1);
    vj_comp.comp.show();
    return vj_comp;
  } catch(Exception e) {
    System.out.println(e);
    return null;
  }
}
public static void getImages(GIFFactory f){
    normalImage = f.GetGIF(out);
    selectedImage = f.GetGIF(in);
}
// Component Initialization
public void VJVScrollbarInit(int x_pt, int y_pt) {
  try {
    String theText = new String("VScrollbar
"+String.valueOf(instanceCount++));
    setNormalIcon(out);
    setSelectedIcon(in);
    bar = new AWTVScrollbar(this);
    setName(theText);
    setComponent((Component)bar);
    setComponentURL(url_name);
    setComponentInfo(info_name);
    VJNodeInit(false,x_pt,y_pt,true);

addPort(port0_info,port0_name,VJPort.InputOutput,VJPort.NorthLeftCe
nter);  // Pin 0

addPort(port1_info,port1_name,VJPort.InputOutput,VJPort.NorthRight
Center);  // Pin 1

addPort(port2_info,port2_name,VJPort.InputOutput,VJPort.SouthCente
r);  // Pin 1
    setImages(normalImage,selectedImage); //Pass references to the
static images down to the node
    nodeRect = new Rectangle(x_pt-3,y_pt-
3,selectedImage.getWidth(vj.theContainer.theDesktop.vp_w)+3,selectedI
mage.getHeight(vj.theContainer.theDesktop.vp_w)+3);
  } catch(Exception e) {
    System.out.println(e);
  }
}
```

```
public void request(int port,int time) { }
public int componentID() { return 3; }
public void disconnecting(int port) {
    switch(port){
        case 0: request_index0= -1; send_index0 = -1;
                break;
        case 1: request_index1 = -1; send_index1 = -1;
                break;
        case 2: request_index2 = -1; send_index2 = -1;
                break;
        }
}

public void connecting(int port) {
   switch(port){
        case 0: request_index0=0; send_index0 = 0;
                vj.request(0,request_index0++,this);
                break;
        case 1: request_index1=0; send_index1 = 0;
                vj.request(1,request_index1++,this);
                break;
        case 2: request_index1=0; send_index2 = 0;
                vj.request(2,request_index2++,this);
                break;
  }
}

   public void load(String s) {
          StringTokenizer tokenStream = new StringTokenizer(s);
          int  max =
Integer.valueOf(tokenStream.nextToken()).intValue();
          int  min =
Integer.valueOf(tokenStream.nextToken()).intValue();
          int  value =
Integer.valueOf(tokenStream.nextToken()).intValue();
          int  visible =
Integer.valueOf(tokenStream.nextToken()).intValue();
          bar.setValues(value,visible,min,max);
   }
   public String save() {
      int max = bar.getMaximum();
      int min = bar.getMinimum();
      int value = bar.getValue();
      int visible = bar.getVisible();
      return max+" "+min+" "+value+" "+visible;}
  public void set(Object o,int port,int time) {
        int max,min,cur;
```

```
            boolean ok = false;
            max = bar.getMaximum();
            min = bar.getMinimum();
            cur = bar.getValue();
            switch(port){
              case 0:
                  if(time==0){
                      if(o instanceof String)
                          { min = Integer.valueOf((String)o).intValue();
ok=true;}
                      if(o instanceof Integer) { min=((Integer)o).intValue();
ok=true;}
                      if(o instanceof Double) { min=((Double)o).intValue();
ok=true;}
                      if(o instanceof Long) { min=((Long)o).intValue();ok=true;
}
                      if(o instanceof Float) { min=((Float)o).intValue();
ok=true;}
                  }
                  break;
              case 1:
                  if(time==0){
                    if(o instanceof String)
                        { max = Integer.valueOf((String)o).intValue();
ok=true;;}
                    if(o instanceof Integer) { max=((Integer)o).intValue();
ok=true;}
                    if(o instanceof Double) { max=((Double)o).intValue();
ok=true;}
                    if(o instanceof Long) { max=((Long)o).intValue();ok=true;
}
                    if(o instanceof Float) { max=((Float)o).intValue();ok=true;
}
                  }
                  break;
              default:
                  if(o instanceof String)
                      { cur = Integer.valueOf((String)o).intValue();ok=true;}
                  if(o instanceof Integer) { cur=((Integer)o).intValue();
ok=true;}
                  if(o instanceof Double) { cur=((Double)o).intValue();
ok=true;}
                  if(o instanceof Long) { cur=((Long)o).intValue();ok=true;}
                  if(o instanceof Float) { cur=((Float)o).intValue();ok=true;}
                  if(ok) vj.request(2,request_index2++,this);
                  break;
            }
```

```
            ok = false;
            bar.setValues(cur,bar.getVisible(),min,max);
          }
            public boolean handleEvent(Event e) {
              if(send_index2>=0&&&e.id<606&&&e.id>600)vj.set((Object)(new
Integer(bar.getValue())),2,send_index2++,this);
              return false;
          }
public void propertiesEditor(){
  if(edit==null){
    edit = new vscrollbarEditor((Frame)(vj.theFrame),this);
    edit.pack();
    edit.resize(10*32,5*32);
    edit.show();
  }
}
public void init(){};
public void start(){};
public void stop(){};
public void destroy(){};
public void reset(){
   request_index0=0; vj.request(0,request_index0++,this);
};
} // end class
class vscrollbarEditor extends Frame
{
    VJVScrollbar vjsb;
    TextField max;
    TextField min;
    TextField visible;
    TextField current;
    Button ok;
    Button cancel;
    boolean dirty = false;
      public vscrollbarEditor (Frame parent,VJVScrollbar c)
      {
            super("Vertical Scrollbar Editor");
          setBackground(Color.lightGray);
            setLayout(new BorderLayout());
        Panel p = new Panel();
        vjsb = c;
        //p.setLayout(new BorderLayout());
      Panel centerPanel = new Panel();
            p.add(new Button("OK"));
            p.add(new Button("Cancel"));
        add("South",p);
        dirty = false;
```

```
            centerPanel.setLayout(new GridLayout(2,4));
            centerPanel.add(new Label("Current"));
            centerPanel.add(new Label("Visible"));
            centerPanel.add(new Label("Maximum"));
            centerPanel.add(new Label("Minimum"));
          current = new TextField(String.valueOf(vjsb.bar.getValue()));
          visible = new TextField(String.valueOf(vjsb.bar.getVisible()));
          max = new TextField(String.valueOf(vjsb.bar.getMaximum()));
          min = new TextField(String.valueOf(vjsb.bar.getMinimum()));
          centerPanel.add(current);
          centerPanel.add(visible);
          centerPanel.add(max);
          centerPanel.add(min);
          add("Center",centerPanel);
        }
        public boolean handleEvent(Event evt)
        {

                switch(evt.id){
                        case Event.ACTION_EVENT:
                        {
                                if("OK".equals(evt.arg))
                                {    vjsb.edit = null;

vjsb.bar.setValues(Integer.valueOf(current.getText()).intValue(),

Integer.valueOf(visible.getText()).intValue(),
                                        Integer.valueOf(min.getText()).intValue(),
                                        Integer.valueOf(max.getText()).intValue());
                         dispose();
                        return true;
                                }
                    if("Cancel".equals(evt.arg))
                    {    vjsb.edit = null;
                         dispose();
                         return true;
                    }
                    return false;
                        }
                        default:
                                return false;
                }
        }
}
```

FIG. **9** depicts an example of a VJScrollbar object **604***b* in the logical view **500**. The physical view **402** illustrates a simple AWT horizontal scrollbar **902** having diamond shaped I/O pins or ports **904**. The diamond shape indicates that the I/O pin is bi-directional or two way in operational nature; that is, they accept inputs or transmit outputs, as they are utilized. The I/O pins can be shaped like a triangle, rather than a diamond. If they are diamond shaped, then those I/O pins will handle an output or an input depending on the direction in which they point. I/O pins **904**, which are sometimes referred to as "net pins", can be coded as follows:

```
import java.awt.*;
public class VJNetPin extends VJNode {
/ / Attributes of this component
static int instanceCount = 0;
static Image normalImage;
static Image selectedImage;
final static String out      = "out__np.gif";
final static String in       = "in__np.gif";
final static String port0__info = "input or output and object";
final static String port0__name = "Pin 0";
final static String url__name = "netpin.html";
final static String info__name = "Connects components inside a
container to a pin of the container";
VJ vj;
netpinEditor edit=null;
VJContainer theContainer;
      boolean connected = false;
      boolean requested = false;
      int theLocation;
      int requestTime = 0;
      int theConnection = -1;
/ / Constructor
public VJNetPin(VJ v){
   super(v);
   vj = v;
}
VJNode dup( ) {
   return null;
}
public static void getImages(GIFFactoryf){
   normalImage = f.GetGIF(out);
   selectedImage = f.GetGIF(in);
}
public void setContainer(VJContainerc) {
   theContainer = c;
}
public void setConnection(int c) {
   theConnection = c;
}
/ / Component Initialization
public void VJNetPinInit(int x__pt, int y__pt) {
   try {
      setNormalIcon(out);
      setSelectedIcon(in);
      setName("VJNetPin");
      setComponent(null);
      setComponentURL(url__name);
      setComponentInfo(info__name);
      VJNodeInit(false,x__pt,y__pt,false);
addport(port0__info,port0__name,VJPort.InputOutput,VJPort.SouthCente
r);   //Pin 0
      setImages(normalImage,selectedImage); / /Pass references to the
static images down to the node
      nodeRect = new Rectangle(x__pt-3,y__pt-
3,selectedImage.getWidth(vj.theContainer.theDesktop.vp__w)+3,selectedI
mage.getHeight(vj.theContainer.theDesktop.vp__w)+3);
   } catch(Exception e) {
      System.out.println(e);
   }
}
public int componentID( ) { return 6; }
public void disconnecting(int port) {
      connected = false;
}
public void connecting(int port) {
   connected = true;
   if(requested) {
      vj.request(0,requestTime,this);
      requested = false;
   }
}
public void load(String s) {
}
public String save( ) {
      return ""; }
public void reset( ) { }
public void request(int port,int time) {
      / / what if theConnection <0 ?
      theContainer.requestOUT(theConnection,time);
}
public void requestIN(int time) {
   if(connected)vj.request(0,time,this);
   else { requestTime = time; requested = true;}
}
public void set(Object o,int port,int time) {
   if(theConnection>=0)
      theContainer.setOUT(o,theConnection,time);
   / / vj.request(0,request__index0++,this);
}
public void setIN(Object o,int time) {
      vj.set(o,0,time,this);
}
public void propertiesEditor( ) {
         if(edit==null){
            edit = new netpinEditor((Frame)(vj.theFrame),this);
            edit.pack( );
            edit.show( );
         }
}
public void init( ){};
public void start( ){};
public void stop( ){};
public void destroy( ){};
}
class netpinEditor extends Frame
{
      VJNetPin vjc;
      TextField tf;
      Button b;
      Button cancel;
         public netpinEditor(Frame parent,VJNetPin c)
         {
               super("Pin Editor");
               setLayout(new BorderLayout( ));
               add("North",new Label("Select a pin"));
               vjc = c;
               tf = new TextField(new Integer(vjc.theLocation).toString( ));
               add("Center",tf);
               b = new Button("OK");
               cancel = new Button("Cancel");
               Panel sp = new Panel( );
               sp.add(b);
                sp.add(cancel);
                add("South",sp);
            }
            public boolean handleEvent(Event evt)
            }     / / System.out.println(evt.toString( ));
                  switch(evt.id){
                        case Event.ACTION__EVENT:
                        {
                              if("OK".equals(evt.arg))
                              {
                        vjc.theLocation =
(Integer.valueOf(tf.getText( ))).intValue( );
                        / / vjc.theContainer.addNewPort(vjc,"fred","jim");
                        vjc.edit = null;
                                    dispose( );
                                    return true;
                              }
                  if("Cancel".equals(evt.arg))
                  {     vjc.edit = null;
                        dispose( );
                        return true;
                  }
                  return false;
                     }
```

-continued

-continued

```
                default:
                    return false;
            }
        }
}
```

FIG. **10** shows the two pin capability of scrollbar **604***b*. Note that each of the pins **902** and **904** are diamond shaped or two way ports. If a value if placed on these ports, it sets the scrollbar to that level. Conversely, if a value is taken from one of these ports, it reflects the position of scrollbar **604***b*.

In practice, the two way or bidirectional ports are first initialized to their two way state. The ports can then function either as an input port or as an output port depending solely on the way they are used.

Each bidirectional port is provided with bidirectional capabilty by having a send message method defined for all outgoing transactions and a receive message method defined for all incoming transactions in the component for each bidirectional port. Thus, the method corresponding to the direction is invoked based on the flow of the message through the port.

For example, if inputs are connected to the two-way ports **904***a* or **904***b* in FIG. **10**, they would function as input ports. Two-way port **906** would then function as the output port since it is the only port left that could serve in that role. In the preferred arrangement, components set themselves internally to reflect the status of each of their bidirectional ports, in accordance with the way they are being used. The bidirectional ports permit greater connective flexibility and save screen real estate as well.

When a connection to another component is completed, the connecting component sends a message to the component at the other end of the connection indicating how its connecting port is set, input or output. The message receiving component then makes sure that its connection participating port is set accordingly. If the message receiving component's port is bidirectional, the port is set opposite to the status of the first connected port. If the message receiving component's connecting port is bidirectional, that port is set opposite to the status of the first connected port. If the message receiving component's port is unidirectional and as such is in conflict with the status of the first connected port, that is, it is set to "output" when the first connected port is also set to "output", the connection is prohibited and an appropriate error message is displayed.

FIG. **11** illustrates the addition of a second vertical scrollbar that will be set to track the range of the Fahrenheit temperature scale. Note that the vertical scrollbar editor **1104** has been adjusted to set scrollbar **1102** to a maximum value of **212** (boiling point) and a minimum value of **32** (freezing point). Prior to being adjusted, scrollbar **1102** has a current value of **71** with only **10** units of its total range actually visible.

Dynamic editing is accomplished by providing each component that would have need of an editor with that capability as an integral part of the class template from which it is instantiated. Each customizer window or editor is defined in predetermined class templates as a method corresponding to the customizer method.

Thus, when such edit capable components are instantiated in either the logical view **402** or the physical view **500**, their built-in customizer or edit widow **1104** is invoked, see FIG. **11**, and opens automatically. The editor appears in the view ready for use to change or customize the properties of the component, in this case scrollbar **604***b*, based on user interaction with the customizer or editing window **1104**.

As shown in the flowchart of FIG. **11**A, editor capability is added at block **1120** to each class template for which an editing capability is desired in component objects instantiated therefrom. An editing window, as indicated by block **1122** is defined as a method corresponding to the editor. The properties and their limits are also defined for each component editor as shown by block **1124**. An editing window is opened by block **1126** when the component with which it is associated is dragged and dropped or instantiated for use.

After the user finishes editing the component's properties and clicks "OK", the editing window is closed and the property changes are accepted and displayed immediately in the appropriate view by block **1128**. After property editing is completed, the editable components are monitored for a user action (usually a mouse click) which indicates that property re-editing is desired for a specific component, as per block **1130**. When that occurs, block **1132** opens the editor widow **1104** again to permit component property changes to be made. Thereafter, control is returned to block **1128** and the user re-editing to changes are accepted. Finally, monitoring of the editable components resumes as per block **1130**.

It is important to note that the user is not required to take any action to invoke an editor or be concerned about the suitability or appropriateness of the editor with respect to the component being customized. Moreover, the editor is customized for the specific component with which it is associated. If an editor appears when a component is instantiated, then the user instantaneously knows that that particular component is customizable. In addition, the user sees and knows just which properties of the component are editable and to what limits. Further, the user can make any desired customizing changes without having to write any code to implement those changes. Other uses of a component editor are shown in FIGS. **12** and **15**.

FIG. **12** shows how VJ Tool is utilized to add text to scrollbars **604***b* and **1102** so that the function they perform or represent can be labeled and thereby identified to any user. First, the simple text field component **506** is invoked by clicking on its icon and dragging it onto the physical view **500**. The text field representation **1202** can then be dropped at any desired location and, as desired, sized to match the element it will identify, in this case scrollbar **604***b*. The text field or label editor **1204** is then used to generate the actual text or scrollbar label.

The label text field component is coded as follows:

```
import java.awt.*;
import java.util.*;
public class VJLabel extends VJNode {
/ / Attributes of this component
public AWTLabel label;
```

-continued

```
static int instanceCount = 0;
labelEditor edit;
static Image normalImage;
static Image selectedImage;
final static String out = "out_la.gif";
final static String in = "in_la.gif";
final static String port0_info = "for setting the text";
final static String port0_name = "Pin 0";
final static String url_name    = "label.html"
final static String info_name    = "A simple AWT label";
VJ vj;
int send_index=0;
int request0_index=0;
// Constructor
public VJLabel(VJ v){
      super(v);
      vj = v;
}
VJNode dup( ) {
      VJLabel vj_comp = new VJLabel(vj);
      try {
         int i = x+40;
         intj = y+40;
         AWTLabel 1 = new AWTLabel(label.getText( ),vj_comp);
         vj_comp.label = 1;
         vj_comp.setNormalIcon(out);
         vj_comp.setSelectedIcon(in);
         vj_comp.setName(label.getText( ));
         vj_comp.setComponent((Component)1);
         vj_comp.setComponentURL(url_name);
         vj_comp.setComponentInfo(info_name);
         vj_comp.VJNodeInit(false,i,j,true);
vj_comp.addPort(port0_info,port0_name,VJPort.Input,VJPort.NorthCe
nter); // Pin 0
         vj_comp.setXPt(0,getXPt(0)+40);
         vj_comp.setYPt(0,getYPt(0)+40);
         vj_comp.setImages(normalImage,selectedImage); / /Pass references
to the static images down to the node
         vj_comp.nodeRect = new Rectangle(i-3,j-
3,selectedImage.getWidth(vj.theContainer.theDesktop.vp_w)+3,selecte
dImage.getHeight(vj.theContainer.theDesktop.vp_w)+3);
         vj_comp.setSelected(true);
         vj.theDocument.add(vj_comp.comp);
         vj_comp.comp.validate( );
vj_comp.comp.reshape(comp.bounds( ).x+50,comp.bounds( ).y+50,comp
.bounds( ).width,comp.bounds( ).height);
         vj_comp.comp.show( );
         return vj_comp;
      } catch(Exception e) {
         System.out.println(e);
         return null;
      }
}
public static void getImages(GIFFactory f){
         normalImage = f.GetGIF(out);
         selectedImage = f.GetGIF(in);
}
/ / Component Initialization
public void VJLabelInit(int x_pt, int y_pt) {
         try {
            String theText = new String("Label
"+String.valueOf(instanceCount++));
            label = new AWTLabel(theText,this);
            label.setFont(new Font("Courier",Font.PLAIN, 14));
            setNormalIcon(out);
            setSelectedIcon(in);
            setName(theText);
            setComponent((Component)label);
            setComponentURL(url_name);
            setComponentInfo(info_name);
            VJNodeInit(false,x_pt,y_pt,true);
            addPort(port0_info,port0_name,VJPort.Input,VJPort.NorthCenter);
// Pin 0
            setImages(normalImage,selectedImage); / /Pass references to the
static images down to the node
         nodeRect = new Rectangle(x_pt-3,y_pt-
      3,selectedImage.getWidth(vj.theContainer.theDesktop.vp_w)+3, selecte
      dImage.getHeight(vj.theContainer.theDesktop.vp_w)+3);
      } catch(Exception e) {
         System.out.println(e);
```

-continued

```
    }
}
public void request(int port,int time) { }
        public int componentID( ) { return 2; }
        public void load(String s) {
        }
        public String save( ) {
           return “”; }
        public void disconnecting(int port) {
        switch(port){
                case 0: request0__index= −1;
                     break;
                }
        }
        public void connecting(int port) {
                switch (port){
                case 0: request0__index=0;
                     vj.request(0,request0__index++,this);
                     break;
                }
}
        public void set(Object o,int port,int time) {
                boolean ok = false;
                if(o instanceof Color) { label.setForeground((Color)o); ok=true; }
                if(o instanceof String) { label.setText((String)o); ok = true;}
                if(o instanceof Long) {
label.setText((String)(((Long)o).toString( ))); ok = true;}
                if(o instanceof Double) {
label.setText((String)(((Double)o).toString( ))); ok = true;}
                if(o instanceof Float) {
label.setText((String)(((Float)o).toString( ))); ok = true;}
                if(o instanceof Integer) {
label.setText((String)(((Integer)o).toString( ))); ok = true;}
                if(o instanceof Boolean) {
label.setText((String)(((Boolean)o).toString( )));ok = true; }
                if(ok) {
                   / / System.out.println(name + “has input at” +
String.valueOf(time)+ “=”+ getText( ));
                   if(time<199) vj.request(0,request0__index++,this);
                }
                ok = false;
           }
              public boolean handleEvent(Event e) {
                 return false;
        }
public void PropertiesEditor( ) {
     if(edit==null){
        edit = new labelEditor((Frame)(vj.theFrame),this);
        edit.pack( );
        //edit.resize(12*32,6*32);
        edit.show( );
     }
}
public void init( ){};
public void start( ){};
public void stop( ){};
public void destroy( ){};
} / / end class VJLabel
class labelEditor extends Frame
{
        VJLabel vjl;
        TextField tf;
        Button ok;
        Button cancel;
        boolean dirty;
           public labelEditor (Frame parent,VJLabel 1)
           {
              super(“Label Editor”);
              setLayout(new BorderLayout( ));
              vjl = 1
              tf = new TextField(vjl.label.getText( ));
              add(“Center”,tf);
              ok = new Button(“OK”);
              cancel = new Button(“Cancel”);
              Panel sp = new Panel( );
              sp.add(ok);
              sp.add(cancel);
              add(“South”,sp);
        }
        public boolean handleEvent(Event evt)
```

-continued

```
    {       / / System.out.println(evt.toString( ));
            switch(evt.id){
                case Event.ACTION_EVENT:
                {
                    if("OK".equals(evt.arg))
                    {
                  vjl.label.setText(tf.getText( ));
                  vjl.edit = null;
                        dispose( );
                        return true;
                    }
                if("Cancel".equals(evt.arg))
                {   vjl.edit = null;
                    dispose( );
                    return true;
                }
                return false;
                  }
                  default:
                      return false;
          }
    }
}
```

As shown in FIG. **13**, text field **1202** has been made into the "CENTIGRADE" label **1202***a* above scrollbar **604***b* through use of the text field editor **1204**. Label "FAHRENHEIT" **1302** has been generated in the same manner and positioned above scrollbar **1102** (not shown in FIG. **13**).

It should be noted that several of the components described herein, vertical scrollbars **604***a* and **604***b* and text field **1202** label editor, are provided with their own editors, vertical scrollbar editor **604** and label editor **1204**, which permits the predefined properties of the associated components to be directly and dynamically edited. Such editing takes place without the user having to exit VJ Tool or having to write any code to support the desired editorial changes.

FIG. **13** also illustrates in logical view **402**, representations of scrollbars, text and bicopy objects that will be used to functionally link scrollbars **604***b* and **1102**. Objects **1306** and **1312** logically represent scroll bars **604***b* and **1102** while label objects **1304** and **1310** represent the labels **1202***a* and **1302** respectively. Bicopy is a backend component that is only found in the logical view palette. A bicopy object, such as **1308** and **1314**, as implemented in accordance with a preferred embodiment of the present invention, will place whatever is input on one of its diamond shaped I/O pins **1308***a*, **1308***b*, **1308***c* or **1398***d* on the other I/O pins.

Bicopy, which functions like a multiplexor, is coded as follows:

```
importjava.awt.*;
import java.util.*;
public class VJBiCopy extends VJNode {
/ / Attributes of this component
static int instanceCount = 0;
static Image normalImage;
static Image selectedImage;
final static String out_bi   = "out_bi.gif";
final static String in_bi    = "in_bi.gif";
final static String port0_info = "Pin 0";
final static String port0_name = "Pin 0";
final static String port1_info = "Pin 1";
final static String port1_name = "Pin 1";
final static String port2_info = "Pin 2";
final static String port2_name = "Pin 2";
final static String port3_info = "Pin 3";
final static String port3_name = "Pin 3";
final static String url_name   = "bicopy.html";
```

-continued

```
final static String info_name   = "Whatever is input on one pin is output on the others";
VJ vj;
      int send_index0 = -1;
      int send_index1 = -1;
      int send_index2 = -1;
      int send_index3 = -1;
      int request_index0 = -1;
      int request_index1 = -1;
      int request_index2 = -1;
      int request_index3 = -1;
/ / Constructor
public VJBiCopy(VJ v){
  super(v);
  vj = v;
}
VJNode dup( ) {
VJBiCopy b = new VJBiCopy(vj);
  try {
      int i = x+40;
      int j = y+40;
      b.setNormalIcon(out_bi);
      b.setSelectedIcon(in_bi);
      b.setName("BiCopy");
      b.setComponent(null);
      b.setComponentURL(url_name);
      b.setComponentInfo(info_name);
      b.VJNodeInit(false,i,j,false);
b.addPort(port0_info,port0_name,VJPort.InputOutput,VJPort.NorthCenter); // Pin 0
      b.addPort(port1_info,port1_name,VJPort.InputOutput,
VJPort.EastCenter); / / Pin 1
b.addPort(port2_info,port2_name,VJPort.InputOutput,VJPort.SouthCenter); // Pin 2
      b.addPort(port3_info,port3_name,VJPort.InputOutput,
VJPort.WestCenter); // Pin 3
      b.setxPt(0,getXPt(0)+40);
      b.setYPt(0,getYPt(0)+40);
      b.setXPt(1,getXPt(1)+40);
      b.setYPt(1,getYPt(1)+40);
      b.setXPt(2,getXPt(2)+40);
      b.setYPt(2,getYPt(2)+40);
      b.setXPt(3,getXPt(3)+40);
      b.setYPt(3,getYPt(3)+40);
      b.setImages(normalImage,selectedImage); / /Pass references to the static images down to the node
      b.nodeRect = new Rectangle(i-3,j-3,selectedImage.getWidth(vj.theContainer.theDesktop.vp_w)+3, selectedImage.getHeight(vj.theContainer.theDesktop.vp_w)+3);
      b.setSelected(true);
      return b;
```

-continued

```
    } catch(Exception e) {
      System.out.println(e);
      return null;
    }
}
public static void getImages(GIFFactoryf){
      normalImage = f.GetGIF(out_bi);
      selectedImage = f.GetGIF(in_bi);
}
// Component Initialization
public void VJBiCopyInit(int x_pt, int y_pt) {
   try {
      setNormalIcon(out_bi);
      setSelectedIcon(in_bi);
      setName("bicopy");
      setComponent(null);
      setComponentURL(url_name);
      setComponentInfo(info_name);
      VJNodeInit(false,x_pt,y_pt,false);
      addPort(port0_info,port0_name,VJPort.InputOutput,
VJPort.NorthCenter); / / Pin 0
      addPort(port1_info,port1_name,VJPort.InputOutput,
VJPort.EastCenter); / / Pin 1
      addPort(port2_info,port2_name,VJPort.InputOutput,
VJPort.SouthCenter); / / Pin 2
      addPort(port3_info,port3_name,VJPort.InputOutput,
VJPort.WestCenter); / / Pin 3
      setImages(normalImage,selectedImage); / / Pass references to the
static images down to the node
      nodeRect = new Rectangle(x_pt-3,y_pt-
3,selectedImage.getWidth(vj.theContainer.theDesktop.vp_w)+3, selectedI
mage.getHeight(vj.theContainer.theDesktop.vp_w)+3);
   } catch(Exception e) {
      System.out.println(e);
   }
}
public void request(int port,int time) { }
public int componentID( ) { return 5; }
public void disconnecting(int port) {
        switch(port){
          case 0:   send_index0 = -1; request_index0 = -1;
                    break;
          case 1:   send_index1 = -1; request_index1 = -1;
                    break;
          case 2:   send_index2 = -1; request_index2 = -1;
                    break;
          case 3:   send_index3 = -1; request_index3 = -1;
                    break;
          }
            }
      public void connecting(int port) {
                    switch(port){
                    case 0:   request_index0=0;send_index0 = 0;
                                        vj.request(0,request_index0++,this);
                                        break;
          case 1:   request_index1=0;send_index1 = 0;
                    vj.request(1,request_index1++,this);
                    break;
          case 2:   request_index2=0;send_index2 = 0;
                    vj.request(2,request_index2++, this);
                    break;
          case 3:   request_index3=0;send_index3 = 0;
                    vj.request(3,request_index3++,this);
                    break;
      }
      }
      public void load(String s) {
      }
      public String save( ) {
        return ""; }
      public void set(Object o,int port,int time) {
        switch (port) {
          case 0:   if (request_index1>0) vj.set(o,1,send index1++,this);
                    if (request_index2>0) vj.set(o,2 send_index2++,this);
                    if (request_index3>0) vj.set(o,3 send_index3++,this);
                    vj.request(0,request_index0++,this);
                    break;
          case 1:   if (request_index0>0) vj.set(o,0,send index0++,this);
                    if (request_index2>0) vj.set(o,2,send_index2++,this);
                    if (request_index3>0) vj.set(o,3,send_index3++,this);
                    vj.request(1,request_index1++,this);
                    break;
          case 2:   if (request_index1>0) vj.set(o,1,send_index1++,this);
                    if (request_index0>0) vj.set(o,0,send_index0++,this);
                    if (request_index3>0) vj.set(o,3,send_index3++,this);
                    vj.request(2,request_index2 ++,this);
                    break;
          case 3:   if (request_index1>0) vj.set(o,1,send index1++,this);
                    if (request_index2>0) vj.set(o,2,send_index2++,this);
                    if (request_index0>0) vj.set(o,0 send_index0++,this);
                    vj.request(3,request_index3++,this);
                    break;
        }
      }
public void propertiesEditor( ) {
}
public void init( ){};
public void start( ){};
public void stop( ){};
public void destroy( ){};
} / / end class VJButton
```

FIG. **13A** illustrates a flowchart of the process by which the bicopy component **1308** shown in FIG. **13** functions. The act of dragging and dropping a new bicopy component onto the logical desktop **402** or of dropping an assembly from folder **542**, which assembly contains a bicopy component, onto the logical view desktop **402** actually starts the bicopy component as called for in block **1330**. A test is next made to see there is a saved, prior state for bicopy element **1308** that needs to be restored by decision block **1332**. If restoration is needed, control is passed to block **1334** which obtains the necessary values and has the ports set accordingly in block **1344**.

If the bicopy component is new, its two-way ports are initialized or set to zero in bock **1336**. Once that has been done, the ports are polled in block **1338** to monitor connection attempts. Decision block **1340** returns control to block **1338** for continued polling if there were no connections made to any of bicopy's component ports. If a proper connection has been made, a connection sufficient to place a value on one of the bicopy componet's ports, control is passed to block **1342** where the type and value of the connection is identified.

Thus, if a connection has been made from a text field, a character string is placed on one of the bicopy component's ports and captured by the Bicopy component. Similarly, if an integer value, such as **32**, isplaced placed on one of the bicopy component's ports, that type and value is also recognized and captured. Once the type and value of an input are known, the remaining ports are set to provide the same type and value as the input by block **1344**. Thus, at this point, see FIG. **16**, bicopy component **1308** would have its port **1308***c* set by the output of scrollbar representation **1306** to the current value (position) of the scrollbar. This means that ports **1308***a*, **1308***b* and **1308***d*, which act as output ports, will carry the output value of scrollbar **1306** until the input connection to port **1308***c* is changed.

Decision block **1346**, which is advised of the initial connection by block **1342**, checks for removal of the input value to bicopy component **1308** and returns control back to block **1344** if it has not been removed or to block **1336** for reinitialization if it has been removed.

FIG. **14** shows addition of splitters **1402** and **1404** in the logical view **402**. Splitter objects **1402** and **1404** are used to connect I/O pins to components that are functionally involved in a defined relationship appearing in the logical view **402**. Splitters are instantiated form the splitter palette

component **558** of logical view **402** and are dragged and dropped to a suitable location on the logical view desktop. Splitter objects are formed pursuant to their implementing code (VJSplit) as follows:

```
import java.awt.*;
import java.util.*;
public class VJSplit extends VJNode {
/ / Attributes of this component
static int instanceCount = 0;
static Image normalImage;
static Image selectedImage;
final static String out      = "OSplit.gif";
final static String in       = "ISplit.gif";
final static String port0_info = "An input output pin";
final static String port0_name = "Pin 0";
final static String port1_info = "An output pin";
final static String port1_name = "Pin 1";
final static String port2_info = "An input pin";
final static String port2_name = "Pin 2";
final static String url_name = "split.html";
final static String info_name = "A Splitter used to connect
input/output pins to componets that are either input or output";
VJ vj;
int send_index2 = 0;
int request_index0 = 0;
int request_index1 = 0;
/ / Constructor
public VJSplit(VJ v){
   super(v);
   vj = v;
}
VJNode dup( ) {
   VJSplit b = new VJSplit(vj);
   try {
      int i = x+40;
      intj = y+40;
      b.setNormalIcon(out);
      b.setSelectedIcon(in);
      b.setName("Splitter");
      b.setComponent(null);
      b.setComponentURL(url_name);
      b.setComponentInfo(info_name);
      b.VJNodeInit(false,i,j,false);
b.addPort(port0_info,port0_name,VJPort.InputOutput,VJPort.NorthCen
ter); //Pin 0
b.addPort(port1_info,port1_name,VJPort.Output,VJPort.SouthLeftCente
r); //Pin 0
b.addPort(port2_info,port2_name,VJPort.Input,VJPort.SouthRightCente
r); //Pin 0
      b.setXPt(0,getXPt(0)+40);
      b.setYPt(0,getYPt(0)+40);
      b.setXPt(1,getXPt(1)+40);
      b.setYPt(1,getYPt(1)+40);
      b.setXPt(2,getXPt(2)+40);
      b.setYPt(2,getYPt(2)+40);
      b.setImages(normalImage,selectedImage); / /Pass references to the
static images down to the node
      b.nodeRect = new Rectangle(i-3,j-
3,selectedImage.getWidth(vj.theContainer.theDesktop.vp_w)+3,selectedI
mage.getHeight(vj.theContainer.theDesktop.vp_w)+3);
      b.setSelected(true);
      return b;
   } catch(Exception e) {
      System.out.println(e);
      return null;
   }
}
public static void getImages(GIFFactoryf){
      normalImage = f.GetGIF(out);
      selectedImage = f.GetGIF(in);
}
/ / Component Initialization
public void VJSplitInit(int x_pt,int y_pt) {
   try {
      setNormalIcon(out);
      setSelectedIcon(in);
      setName("Splitter");
      setComponent(null);
      setComponentURL(url_name);
```

-continued

```
      setComponentInfo(info_name);
      VJNodeInit(false,x_pt,y_pt,false);
addPort(port0_info,port0_name,VJPort.InputOutput,VJPort.NorthCente
r); //Pin 0
addport(port1_info,port1_name,VJPort.Output,VJPort.SouthLeftCenter);
// Pin 0
addPort(port2_info,port2_name,VJPort.Input,VJPort.SouthRightCenter);
// Pin 0
      setImages(normalImage,selectedImage); / /Pass references to the
static images down to the node
      nodeRect = new Rectangle(x_pt-3,y_pt-
3,selectedImage.getWidth(vj.theContainer.theDesktop.vp_w)+3,selectedI
mage.getHeight(vj.theContainer.theDesktop.vp_w)+3);
   } catch(Exception e) {
      System.out.println(e);
   }
}
public int componentID( ) { return 12; }
      public void disconnecting(int port) { }
      public void connecting(int port) { }
      public void load(String s) {
      }
      public String save( ) {
         return ""; }
      public void propertiesEditor( ) {}
      public void reset( ) {}
      public void request(int port,int time) {
            switch(port){
            case 0:   vj.request(2,time,this);
                  break;
            case 1:   vj.request(0,time,this);
                  break;
            }
      }
      public void set(Object o,int port,int time) {
            switch(port){
            case 0:   vj .set(o,1,time,this);
                  break;
            case 2:   vj.set(o,0,time,this);
                  break;
            }
      }
public void init( ){};
public void start( ){
public void stop( ){
};
public void destroy( ){ };
}
```

FIG. **15** shows the addition of a calculator object **1502**. Calculator object **1502** is instantiated from calculator component **572** of the logical view palette when the mouse is clicked over the calculator icon and the resulting image is dragged into the logical view window. When calculator object **1502** is created, evaluator editor **1504** is popped up so that expressions to be evaluated by the calculator can be input thereto. In this particular example, the Fahrenheit to Centigrade conversion expression to be evaluated is entered and the calculator is thereby informed what its computational task will be.

FIG. **16** illustrates the interconnections of several objects to achieve the appropriate Centigrade/ Fahrenheit relationship between scroll bars **604***b* and **1102**. Building on to the arrangement depicted in FIG. **15**, the user would add two simple text field objects **1602** and **1603** in physical view **500** by clicking on the simple text field icon **506** twice and then dragging and dropping each resultant text field object **1602** and **1603** so that each is located below and adjacent to the scrollbar it contains information for.

When the text field objects are created, logical representations thereof, **1604** and **1606** respectively, are created by VJ Tool in the logical window. The appropriate interconnections between and amongst the several objects in the logical view **402** are then made and the results displayed in

the text fields **1602** and **1604** as a direct function of where the scrollbars are actually located. Since scrollbar **604***b* is at its minimum position, which is zero, text field **1602** accurately displays that result. The display of the position results in a text field without the intervening need to write additional code to transform the scrollbar output, an integer or floating point value to an ASCII string. VJ Tool takes care of that task for the user and permits concentration on the problem being solved.

VJTextField is coded as follows:

```
import java.awt.*;
import java.util.*;
public class VJTextField extends VJNode {
// Attributes of this component
public AWTTextField text;
static int instanceCount = 0;
textfieldEditor edit;
static Image normalImage;
static Image selectedImage;
final static String out = "out_te.gif";
final static String in  = "in_te.gif";
final static String port0_info  = "for getting or seeting the current text";
final static String port0_name  = "Pin 0";
final static String url_name    = "textfield.html";
final static String info_name   = "A simple AWT textfield";
VJ vj;
int send_index = -1;
int request_index = 0;
int c_width, c_height;
// Constructor
public VJTextField(VJ v){
  super(v);
```

-111-

```
    vj = v;
  }
  VJNode dup() {
   VJTextField vj_comp = new VJTextField(vj);
   try {
     int i = x+40;
     int j = y+40;
     AWTTextField t = new AWTTextField(text.getText(),vj_comp);
     vj_comp.text = t;
     t.setFont(text.getFont());
     vj_comp.setNormalIcon(out);
     vj_comp.setSelectedIcon(in);
     vj_comp.setName(text.getText());
     vj_comp.setComponent((Component)t);
     vj_comp.setComponentURL(url_name);
     vj_comp.setComponentInfo(info_name);
     vj_comp.VJNodeInit(false,i,j,true);

  vj_comp.addPort(port0_info,port0_name,VJPort.InputOutput,VJPort.S
  outhCenter);  // Pin 0
     vj_comp.setXPt(0,getXPt(0)+40);
     vj_comp.setYPt(0,getYPt(0)+40);
     vj_comp.setImages(normalImage,selectedImage);  //Pass references
  to the static images down to the node
     vj_comp.nodeRect = new Rectangle(i-3,j-
  3,selectedImage.getWidth(vj.theContainer.theDesktop.vp_w)+3,selecte
  dImage.getHeight(vj.theContainer.theDesktop.vp_w)+3);
     vj_comp.setSelected(true);
     vj.theDocument.add(vj_comp.comp);
     vj_comp.comp.validate();

  vj_comp.comp.reshape(comp.bounds().x+50,comp.bounds().y+50,comp
  .bounds().width,comp.bounds().height);
     vj_comp.comp.show();
     return vj_comp;
   } catch(Exception e) {
     System.out.println(e);
     return null;
   }
  }
  public static void getImages(GIFFactory f){
     normalImage = f.GetGIF(out);
     selectedImage = f.GetGIF(in);
  }
  // Component Initialization
  public void VJTextFieldInit(int x_pt, int y_pt) {
    try {
```

```
    String theText = new String("TextField
"+String.valueOf(instanceCount++));
    text = new AWTTextField(theText,this);
    text.setFont(new Font("Courier", Font.PLAIN, 14));
    setNormalIcon(out);
    setSelectedIcon(in);
    setName(theText);
    setComponent((Component)text);
    setComponentURL(url_name);
    setComponentInfo(info_name);
    VJNodeInit(false,x_pt,y_pt,true);

addPort(port0_info,port0_name,VJPort.InputOutput,VJPort.SouthCent
er);  // Pin 0
    setImages(normalImage,selectedImage);  //Pass references to the
static images down to the node
    nodeRect = new Rectangle(x_pt-3,y_pt-
3,selectedImage.getWidth(vj.theContainer.theDesktop.vp_w)+3,selecte
dImage.getHeight(vj.theContainer.theDesktop.vp_w)+3);
  } catch(Exception e) {
    System.out.println(e);
  }
}

public void request(int port,int time) {}
public int componentID() { return 3; }
public void disconnecting(int port) {
    send_index= -1;
}

public void connecting(int port) {
  request_index=0;
  send_index = 0;
  vj.request(0,request_index++,this);
}

   public void load(String s) {
        StringTokenizer tokenStream = new
StringTokenizer(s,"@",false);
                String data =
tokenStream.nextToken().replace('^','\t').replace('&',' ');
        if(data.startsWith(" ")) data = data.substring(1);
            text.setText(data);
                String family = tokenStream.nextToken();
        boolean bold =
Boolean.valueOf(tokenStream.nextToken()).booleanValue();
```

```
            boolean italic =
Boolean.valueOf(tokenStream.nextToken()).booleanValue();
            int size =
Integer.valueOf(tokenStream.nextToken()).intValue();
            int theStyle = Font.PLAIN;
            if(bold) theStyle = theStyle+Font.BOLD;
            if(italic) theStyle = theStyle+Font.ITALIC;
            text.setFont(new Font(family, theStyle, size));
                        if(!vj.isMicrosoft)
vj.doResize(this,text.size().width,text.size().height);
    }
    public String save() {
        String family = text.getFont().getName();
        int size = text.getFont().getSize();
        boolean bold = text.getFont().isBold();
        boolean italic = text.getFont().isItalic();
        return text.getText().replace('
','&').replace('\t','^')+"@"+family+"@"+bold+"@"+italic+"@"+size; }


     public void set(Object o,int port,int time) {
          boolean ok = false;
          if(o instanceof Color) { text.setForeground((Color)o); ok=true; }
          if(o instanceof String) { text.setText((String)o); ok = true;}
          if(o instanceof Long) { text.setText((String)(((Long)o).toString()));
ok = true;}
          if(o instanceof Double) {
text.setText((String)(((Double)o).toString())); ok = true;}
          if(o instanceof Float) { text.setText((String)(((Float)o).toString()));
ok = true;}
          if(o instanceof Integer) {
text.setText((String)(((Integer)o).toString())); ok = true;}
          if(o instanceof Boolean) {
text.setText((String)(((Boolean)o).toString()));ok = true;  }
          if(ok) {
            //System.out.println(name + " has input at "+
String.valueOf(time)+ " = "+ getText());
            if(time<199) vj.request(0,request_index++,this);
          }
          ok = false;

      }
        public boolean handleEvent(Event e) {
          if(e.id == 1001) {
              if(send_index>=0)
              vj.set((Object) text.getText(),0,send_index++,this);
          }
```

```
            switch(e.id){
              case VJEvent.DOUBLECLICK: propertiesEditor(); break;
              //case 0: set(e.arg,0); System.out.println("GOT TF 0
"+e.toString()); break;
            }
            return false;
        }
    public void propertiesEditor() {
      if(edit==null){
        edit = new textfieldEditor((Frame)(vj.theFrame),this);
        edit.pack();
        edit.resize(12*32,6*32);
        edit.show();
      }
    }
    public void init(){};
    public void start(){};
    public void stop(){};
    public void destroy(){};
    } // end class VJButton

    class textfieldEditor extends Frame
    {
        VJTextField vjtf;
        TextField tf;
        Button ok;
        Button cancel;
        Choice fonts;
        Font compFont;
        Checkbox bold;
        Checkbox italic;
        TextField size;
        String fontnames[];
        boolean dirty;
          public textfieldEditor (Frame parent,VJTextField l)
          {
                super("TextField Editor");
              setBackground(Color.lightGray);
                setLayout(new BorderLayout());
            Panel p = new Panel();
          Panel centerPanel = new Panel();
                p.add(new Button("OK"));
                p.add(new Button("Cancel"));
            add("South",p);
            vjtf = l;
            dirty = false;
            Panel PN = new Panel();
```

-115-

```
            fonts = new Choice();
            fontnames = vjtf.text.getToolkit().getFontList();
            compFont = vjtf.text.getFont();
            for (int i = 0; i < fontnames.length; i++) {
                 fonts.addItem(fontnames[i]);

if(fontnames[i].equals(compFont.getFamily()))fonts.select(i);
            }
              fonts.setBackground(Color.lightGray);
            bold = new Checkbox("Bold");
            bold.setState(compFont.isBold());
            italic = new Checkbox("Italic");
            italic.setState(compFont.isItalic());
            size = new TextField(String.valueOf(compFont.getSize()));
            tf = new TextField(vjtf.text.getText());
              centerPanel.setLayout(new GridLayout(2,3));
              centerPanel.add(new Label("Fonts"));
              centerPanel.add(new Label("Text"));
              centerPanel.add(new Label("Font Size"));
            centerPanel.add(fonts);
            centerPanel.add(tf);
            centerPanel.add(size);
            Panel textP = new Panel();
            textP.add(bold);
            textP.add(italic);
            PN.add(textP);
            add("North",PN);
            add("Center",centerPanel);
}
        public boolean handleEvent(Event evt)
        {       //System.out.println(evt.toString());
                switch(evt.id){
                   case Event.ACTION_EVENT:
                  {
                    if("OK".equals(evt.arg))
                    {
                         int theStyle = Font.PLAIN;
                         if(bold.getState()) theStyle = theStyle+Font.BOLD;
                         if(italic.getState()) theStyle = theStyle+Font.ITALIC;
                         vjtf.text.setFont(new Font(fonts.getSelectedItem(),
theStyle, Integer.valueOf(size.getText()).intValue()));
                         vjtf.text.setText(tf.getText());
                         if(!vjtf.vj.isMicrosoft)
vjtf.vj.doResize(vjtf,vjtf.c_width,vjtf.c_height);
                                 dispose();
                                 return true;
                        }
```

```
                    if("Cancel".equals(evt.arg))
                    {
                        dispose();
                        return true;
                    }
                    return false;
                    }
                    default:
                        return false;
                }
            }
        }
```

The AWTTextField.Java is as follows:

```
import java.awt.*;
public class AWTTextArea extends TextArea {
    VJTextArea vjt;
    public AWTTextArea(String n,VJTextArea v){
      super(n);
      vjt = v;
      setFont(new Font("Courier", Font.PLAIN, 14));
    }
    public boolean handleEvent(Event e) {
        return vjt.handleEvent(e);
    }
}
```

In this example, interconnections are made by mouse click, drag and drop operations as follows. The output of scrollbars **1306** and **1308** are connected to the bicopy objects **1308** and **1314** respectively. That value is passed from bicopy object **1308** to splitter **1402** and text field representation **1604** and from bicopy object **1314** to splitter **1404** and text field representation **1606**. In addition, the output of splitter **1402** is coupled to the input of calculator **1502***a* while the output of splitter **1404** is coupled to the input of calculator **1502***b*. Finally, the outputs of calculators **1502***a* and **1502***b* are respectively connected to the inputs of splitters **1402** and **1404**. Thus, when scrollbar **604***b* is moved to a new position, the value of that position is transmitted by the scrollbar object **1306** to bicopy object **1308** and from there to text field component representation **1604**. This means that the text fields **1602** and **1603** both display the changing values for their associated scrollbars **604***b* and **1102** when either one of them is moved to a new position.

It is rather important to note that the interconnections described above between objects on the logical view are subject to type and functionality checking in a dynamic manner when they are attempted. Thus, the connection in FIG. **16** that was made between the output port of splitter **1402** and the input port of calculator **1502***a* is functionally permissible and was permitted to be made in a manner that was transparent to the user. Conversely, if an attempt had been made to connect the output port of splitter **1402** to the output port of calculator **1502***a*, that attempt would have been denied as functionally impermissible. In a similar manner, had an attempt been made to the output of calculator **1502***a* to the input of text label object **1304**, that connection would have been denied since the input type (a value or number) was mistyped as an input to text label object **1304** which only accepts input of type char or a string of characters. This functional and type compatibility checking is performed by the VJDesktop code as set forth above.

The port or netpin type verification works in the following functional manner. When a component or object pin is created by being dropped onto the logical view desktop **402**, its presence there and the number and nature of its pins, if any, is logged, stored and tracked by the VJDesktop code. Specifically, the number and types of ports or netpins on the newly instantiated component or object is noted Once a component or object having pins is instantiated, VJDesktop tracks and stores the status of its ports by polling them periodically as depicted by block **1620** in FIG. **16**A. The same is true for variables, the information for which is initially stored when a component that can pass, duplicate or manipulate a variable is instantiated.

As used herein, the term "initiate a connection" means that the mouse has been clicked over only one port in preparation for tacking the line that appears to another port. Once that other port is clicked on, the connection is deemed to be completed.

Decision block **1622** is advised by block **1620** whether or not a connection to one of the ports has been initiated. If no attempt to initiate a connection has been made, polling continues. If a connection has been initiated, the type of port involved (input, output or bidirectional) and, if known, the type of variable expected (character, float, long integer, short integer, string, etc.) on that port are stored as per block **1624** with VJDesktop and control waits for completion of a connection for the involved port while polling continues for the remaining ports.

Decision block **1626** sends control back to polling if the pending connection has not yet been made. If the connection is completed, control for the ports involved is passed to decision block **1628** which decides if the attempted complete connection between the ports involved is valid. The type of ports involved and their functional affinity for each other will be checked and verified. Connections directly between an input port on one component will not be allowed to an input port on another component nor will a direct connection between an output port on a first container to an output port on a second container. Also forbidden are connections between ports on the same component regardless of their type.

In addition to checking that interport connections are valid, decision block **1628** also ascertains if the variable to be transmitted across the new connection is valid for both ports. By referring to the stored component and object port information, it can be determined, for example, that the variable at the output of calculator **1502***a* in FIG. **16** is mistyped as to the variable expected at the input of label **1304**, a character or string. As a result, when that otherwise valid output to input connection is attempted, it would be prevented by decision block **1628** because of a variable type mismatch.

When the attempted connection is invalid, an error message will be sent to the screen for the user to see and notification is sent to block **1620** to keep on polling for completion of the initiated, but not completed connection. If the attempted connection is valid, it is completed and also reflected on the display and the polling block **1620** is so advised. The stored port information is updated and the system waits for the next attempted connection. If a completed connection is ended, decision block **1634** is so advised by polling block **1620** and the stored type information for that connection is appropriately adjusted to reflect that the ports which were involved in the ended connection are now free for other use.

FIG. **17** shows the final result of the coupled scrollbars with correct Fahrenheit and Centigrade temperatures shown in text fields **1602** and **1603**, respectively. With both scrollbars at their minimum positions, the Centigrade scrollbar **604***b* position produces the value 0 in text field **1602**. In similar fashion, scrollbar **1102** produces a value of 32 in text field **1603**. If scrollbar **604***b* is pulled down to position **1702** where it has a value of 80, as will then be displayed in text field **1602**, then scrollbar **1102**, because of what are essentially feedback connections made in FIG. **16**, will move to position **1704** which will cause text field **1603** to then display its corresponding value of 176 degrees. Because of the cross coupling described in connection with FIG. **16**, moving scrollbar **1102** first to a position of 176 would cause scrollbar **604***b* to be positioned at the point that represents the value 80, which would be displayed in text field **1602**.

```
import java.net.*;
import java.io.*;
import java.util.Vector;
class ServerConnection extends Thread
{
   private Socket          _mysocket;
   private PrintStream   _output;
   private DataInputStream    _input;
   String id;
   ConnectionManager creator;
   int intId;
   private Socket some_server = null;
   private DataInputStream in;
   private PrintStream out;
   private int clientType;
   theClient XXXXserver;
       private void doServerWork()
       {
         Parser p;
         String temp;
         String command;
         while(true){
           while(!inputWaiting())
                 Thread.yield();
           String s = receive();
       // Dump a copy of rec input to console to see waht is happening
       // uncomment next line in development
       // System.out.println(id + " -> " + s);
       // Parse the input string
          p = new Parser(s);
       // determine the command recieved from the client
       command = p.arg(0);
       if(!p.isValid()){
         send("--" + command);
                }
                else if(command.compareTo("Confirm") == 0){
         send("--" + command + " confirmed");
                }
                else if(command.compareTo("SendAll") == 0){
         creator.sendToAll(intId + " -> " + p.arg(1));
                  send("--" + command + " confirmed");
                }
```

```
                else if(command.compareTo("Connect") == 0){
                  send(handleConnect(p, s));
                }
                else if(command.compareTo("Command1") == 0){
                  send(handleFileServer(p, s));
                }
                else if(command.compareTo("Command2") == 0){
                  send(handleFileServer(p, s));
                }
                else if(command.compareTo("Command3") == 0){
                  send(handleFileServer(p, s));
                }
                else if(command.compareTo("Command4") == 0){
                  send(handleFileServer(p, s));
                }
            // Add more commands as required
                else{
           send("--Unknown request - " + command);
                }    }
          }

    private String handleFileServer(Parser p, String s){
        String command = p.arg(0);
        XXXXserver.send(s);
        return XXXXserver.receive();
          }
          public DataInputStream getDataInputStream(){
        return in;
          }

          public PrintStream getPrintStream(){
        return out;
          }
          public void handleMessage(String s){
          }
       private String handleConnect(Parser p, String s){
        if(initSocket(p.arg(1),Integer.valueOf(p.arg(2)).intValue())){
          clientType = TypesOfClients.CONNECTED_CLIENT;
                XXXXserver = new theClient(this);
                return("--" + XXXXserver.receive());
        }
        clientType = TypesOfClients.NORMAL_CLIENT;
        return ("--Failed connecting to "+ p.arg(1) + ":" + p.arg(2));
      }
    private boolean initSocket(String addr, int port){
          try{
           some_server = new Socket(addr, port);
```

```
            in = new DataInputStream(some_server.getInputStream());
            out = new PrintStream(some_server.getOutputStream());
          }
          catch(Exception e){
            try
            {
              some_server.close();
            }
            catch(Exception e2)
            {
              System.err.println("Exception:\n" + e);

              return false;
            }
            return false;
          }
          return true;
        }
          public ServerConnection(Socket s, ConnectionManager c, int
          id1)
                {
                        _mysocket = s;
                        creator = c;
                intId = id1;
                        clientType = TypesOfClients.NORMAL_CLIENT;   }

      public boolean send(String s){
            System.out.println("Sending " + s);
            try{
        _output.println(s);
       }
            catch(Exception e){
          return false;
            }
            return true;
          }

        private String receive(){
            try{
          return _input.readLine();
            }
            catch(Exception e){
            }
            return "";
          }
```

```
        private boolean inputWaiting(){
          try{
            return (_input.available() != 0);
          }
          catch(Exception e){
          }
          return false;
    }

        public void run()
        {
                id = _mysocket.getInetAddress() + ":" +
_mysocket.getPort();
                System.out.println("New Client : " + id);
                try
                {
                _output = new
PrintStream(_mysocket.getOutputStream());
                _input = new
DataInputStream(_mysocket.getInputStream());
                   send(" Your id is " + intId);
                       doServerWork();
                       _mysocket.close();
                }
        catch ( Exception e )
                {
                       System.err.println( "Exception:\n" + e );
                }


                System.out.println("Disconnecting : " + id);
                stop();
        }
    }

    class TypesOfClients{
      static int NORMAL_CLIENT = 1;
      static int CONNECTED_CLIENT = 2;
    }
    class Parser{
      String args[] = new String[10];
      int n;
      boolean valid;

    public Parser(String s){
       if (parse(s))
            valid = true;
```

```
        else
          valid = false;
    }

5

    public boolean isValid(){
      return valid;
    }

10

    public String arg(int i){
      if(i <= n)
            return args[i];
      else
15          return "";
    }


    public int getNumberOfArgs(){
20    return n;
    }

  private boolean parse(String s){
    String out = "";
25  int i = 0;
    int commas[] = new int[10];
        int start, end;
    int count = 0;
        int openingB = s.indexOf("{");
30      if(openingB == -1){
          args[0] = "No Opening Parantheses";
          n = 1;
          return false;
      }
35

        int lastPos = openingB;
        args[count] = s.substring(0, lastPos);
        out = out + "{" + args[count] + "}";
        count = count + 1;
40

    boolean GoOn = true;
        while(GoOn){
     start = s.indexOf("'", lastPos);
        if(start == -1){
45            GoOn = false;
     }
        else{
```

```
            end = s.indexOf("", start+1);
                if(end == -1){
                  args[0] = "Unmatched apostrophes";
                  n = 1;
                  return false;

        }
                commas[i] = s.indexOf(",", end+1);
                if(commas[i] == -1){
                  commas[i] = s.indexOf(")", end+1);
                  if(commas[i] == -1){
                        args[0] = "Something's wrong";
                        n = 1;
                        return false;
          }
                }

            args[count] = s.substring(start + 1, end);
                out = out + "{" + args[count] + "}";
            count = count + 1;
                lastPos = commas[i];
                i = i + 1;
      }
        }

        System.out.println(out);
        n = count;
        return true;
    }
}

// This is the MAIN routine for the server
// It initializes on a predetermined socket port.  There can be many
// sockets for a particular computer that may have a unique IP
address.
// In this case port # 4000
// The corresponding collaborative component must use this
// socket to communicate with this server
// You must make sure that no other services are using this
// socket number.

class GenericServer
{
        private static final int DEFAULT_PORT=4000;
        private ConnectionManager cm = null;
        public GenericServer(int port)
        {
```

```
                System.out.println("Server using port " + port);
                cm = new ConnectionManager(port);
                cm.start();
        }

        public static void main(String args[])
        {
                int server_port;
                try
                {    // See if the user is using a commandline argument
to
                // choose a different port for the service
                        server_port = Integer.parseInt(args[0],10);

                }
                catch(Exception e)
                {

                        System.out.println("Defaulting to port " +
DEFAULT_PORT);
                        server_port = DEFAULT_PORT;
                }
                new GenericServer(server_port);
        }
}

// Wait for a connection then act on it

class ConnectionManager extends Thread
{
        private static int _port;
        private static Vector _my_threads = new Vector(5,2);
        private ServerSocket _main_socket = null;
        public ConnectionManager(int port)
        {
                _port                           = port;
        }

        public void run()
        {
                serveRequests();
        }

      public void sendToAll(String msg){
        ServerConnection s;
        for(int i = 0; i < _my_threads.size(); i++){
          s = (ServerConnection)(_my_threads.elementAt(i));
```

```
        // For each client connected send out message
        s.send(msg);
      }
    }

    private void serveRequests()
    {
        try {_main_socket = new ServerSocket(_port);}
        catch(Exception e) { System.err.println(e); System.exit(1);}
        ServerConnection temp_sc = null;
        System.out.println(_main_socket.toString());
        while (true)
        {
            try
            {
                Socket this_connection =
_main_socket.accept();
                temp_sc = new
ServerConnection(this_connection, this, _my_threads.size());
                temp_sc.start();
                _my_threads.addElement(temp_sc);
                //clean up the vector if needed
                for(int
i=0;i<ConnectionManager._my_threads.size();i++)
    if(!((ServerConnection)(_my_threads.elementAt(i))).isAlive())
                        _my_threads.removeElementAt(i);
            }
            catch(Exception e)
            {
                System.err.println("Exception:\n" + e);
            }
        }
    }
}
```

As described above, the VJ Tool provides a live development or authoring environment in which socialization among objects or components can occur immediately upon their creation or instantation without any wait to plan or test their integration. For example, as shown in FIG. **16**, once the output of bicopy object **1308** was connected to text field representation **1604**, the output value of scrollbar **1306** was displayed in the physical view **500**. If this result is not what was desired, the user can change the connection or add another component on the fly without having to debug code or review a flowchart. Similarly, when the output of splitter **1404** is connected to the input of calculator **1502***b* and displayed via text field representation **1606**, the user is able to make an immediate determination that the conversion calculations are correct and that the displayed arrangement is satisfactory. In other words, being able to make connections on the fly immediately proved or disproved the results obtained because VJ Tool creates a "live" environment wherein applet design creation and trial are integrated so that the result is then played out virtually simultaneously with creation. This is analogous to building a hardware prototype or test board by connecting, disconnecting and moving components around the board while the power is on!

Component **542** of FIG. **5** is a folder component in which associated components can be stored to act as templates for other applets to be designed in the future. Say, for example, that a user had designed the specific arrangement shown in FIG. **16** and dragged it as a component assembly into an object folder instantiated from folder **542**. That object folder can later be opened and the component assembly stored therein be reused or its calculators modified to display Centigrade versus Kelvin or with slightly more modification to the text and label fields, feet versus meters. In fact, a hierarchy of folders can be built up in this manner. Unlike ordinary folders which are static and store only files that can be copied in an ordinary fashion, component folder **542** actually stores parts or all of a program with its interconnections intact.

To build a hierarchical component, a component is instantiated on a logical or physical display. Then, a hierarchical component folder is selected and instantiated on the display. The customization (edit) window is completed to reflect an appropriate name for the particular component folder and the customization window is closed. Another window is presented for receipt of one or more components and their connections to capture and create the "hierarchical component." Thus, the hierarchical component acts as an organizer to capture debugged logic and make it available to other applets without modification.

There are several kinds of components in VJ Tool. For example, as shown in FIG. **5**, there is a GUI primitive such as **508**, a primitive spreadsheet **524**, a primitive backend component **570** (calculator) and a backend component **558** (splitter). In addition, some of the components have the ability to be made collaborative, that is, they can interact with each other to show or indicate interdependencies. For example, if three users are working with collaborative spreadsheets, a change made by one user will also be reflected in the spreadsheets of the other two users. This makes it easy to keep all members of a team current with respect to changes in spreadsheet information. Under VJ Tools, collaborative components work as follows.

To begin the collaboration process, a standard VJ Tool component, such as a spreadsheet **524**, is created from the physical view palette of VJ Tool, see FIG. **5**. As shown in FIG. **18**, there would be a copy, **524***a*, **524***b* and **524***c*, of each spreadsheet object instantiated for each client user, **1806***a*, **1806***b* and **1806***c*, that wanted their spreadsheet to be collaboratively coupled to other spreadsheets. Collaboration can be extended to the entire spreadsheet or it can be limited to designated cells in the spreadsheet. For example, individual cells in each spreadsheet can be collaborated by simply clicking on them or the entire spreadsheet can be collaboratively coupled by simultaneously pressing the <CONTROL> key while clicking on any portion of the spreadsheet. It is also possible to have two collaborating spreadsheets completely linked to each other while one of these is linked to a third spreadsheet on a designated cell basis only.

All such standard components to be collaborated are augmented with code than connects them to a VJ Spreadsheet Server, a Java application, that is running on the same HTTP server as the VJ Tool applet. VJ Spreadsheet Server is responsible for managing the collaboration. This arrangement is necessitated by the fact that this is the only way a Java applet, when VJ Tool is implemented as a Java applet, can interact with a Java server application through a designated socket.

The clients, **1808***a*, **1808***b* and **1808***c*, are typically connected across the Internet **1810** to an HTTP server **1802**. The HTTP server **1802** can include many applications and applets and it often does, but for the sake of clarity there are only three applications, **1804***a*, **1804***b* and **1804***c*, and three applets, **1806***a*, **1806***b* and **1806***c*, shown. Application **1804***c*, designated for purposes of this explanation as the Java Server, is usually a daemon server, has full access to the underlying file system and can be used to communicate with related servers, not necessarily Java servers, on the Internet.

In the simplest mode, collaborative capable components, are associated with one or more Java servers running on the same HTTP server that houses and services the VJ Tool applet. As each instance of such components are created and deployed in the VJ Tool environment, and collaboration is desired, each collaborative component to be is registered with the Java server, in this case **1804***c*. The process of registration builds an instance **1812***a* of the registering component **524***a* in Server **1804***c*. It will also build a similar instance of the other components involved, **1812***b* and **1812***c*, as they are registered. Once registered with the Java Spreadsheet Server **1804***c*, the component, assume it's **524***a* for purposes of this discussion, sends out information to Server **1804***c* based on interactions with the user and possibly other registered components, **524***b* and **524***c*, in the deployment environment; that is; other collaborative components to which a changing component is tied. In addition, the collaborated component **524***a* will receive information from Server **1804***c* which it may choose to use as feedback to the user or to the other collaborated components with which it is so associated. Basically, the message set "Publish cell", "Unpublish cell" and "Update cell" is used to alter cell content.

However, each time the collaborative arrangement is initialized, nothing is shared between the collaborated components unless the state of the last session was saved and reloaded at initialization into Spreadsheet Server **1802**. Since the registration process builds a record in Server **1804***c* of which portions of which collaborated components are coupled, it is relatively straightforward for the Server to accumulate this information from a changed component, which utilizes a publish message to send it there and then republish or broadcast it to the other collaborated components to effect updating, thereby making it public. Thus, nothing is seen by any of the unchanged collaborated components until the Spreadsheet Server **1802** has relayed

the changed information on to them.

A flowchart of the collaboration process is illustrated in FIG. **19**. When a new component is created as in block **1902**, the user is asked by decision block **1904** if the new component should be collaborative. If not, the user and VJ Tool go off via block **1906** and do something else. If the user responds in the affirmative to the query of block **1904**, the component properties are examined to determine if this specific component can be collaborated by decision block **1908**. If collaboration isn't possible, control is passed to block **1910** which sends an appropriate message to the user and then waits for the user to make another request.

If a new component can be collaborated, it is registered with a Java server as shown in function block **1912**. The server, as indicated by block **1914**, then builds an instance of the registering component in order to know which components it is responsible for. In addition, pursuant to block **1916**, the server builds a record listing those portions, some or all, of the registered components which are linked or collaborated. Once that identity and designated linked portions of the components have been identified and recorded, the server changes the information in the collaborated portions when it receives information from a component as shown in block **1918** and broadcasts the changed information to the other collaborated components via block **1920**.

Collaboration within the VJ Tool, in accordance with the foregoing description, is accomplished utilizing the source code presented below.

```
import java.awt.*;
import java.net.*;
import java.io.*;

public class VJChat extends TextArea implements VJContext {
    static String info_url = "VJChat.html";
    static String quick_info = "Chat component - chat to others using
VJ specify user name by doubleclicking icon";
    static String port_name[] = {"send in","send out"};
    static String ports_info[] = {"messages to send to chat (attach to
textField)","all incoming messages (attach to textarea)"};
    static int port_type[] = { VJPort.Input, VJPort.Output};
    static int port_location[] = { VJPort.NorthCenter
,VJPort.SouthCenter};
    static int numberOfPorts = 2;
    static Image normalImage;
    static Image selectedImage;
    private auxClient client;
    static int instanceCount = 0;
    // Instance specific attributes
```

```
String name;
// To send messages to the visualJava kernel
visualJava vj;
  public VJChat(visualJava v){
      super();
      vj = v;
      client = new auxClient(this, vj);
      client.startUp();
      name = new String("Chat "+String.valueOf(instanceCount++));
  }
public static void getImages(GIFFactory f){
          normalImage = f.GetGIF("chat.gif");
          selectedImage = f.GetGIF("chat.gif");
}
String clientname = new String("");
public void setName(String s){
  clientname = s;
  client.write("SetName(\"" + clientname + "\")");
}
public void handleMessage(byte msg[]){
      try{
      String s = new String(msg, 0);
      if(!s.startsWith("--")){
        s = s.substring(0, s.indexOf("zzyx"));
    // Output the message rec from the SERVER on port 1
    // So you can see what is being chatted about!
    vj.set((Object)s, 1, send_index++, (Component)this);
  }
  }
      catch(Exception e){};
};
public boolean editorOpen = false;
public void propertiesEditor() {
  if(!editorOpen){
    propsEditor edit = new propsEditor((Frame)(vj.main_w),this);
    edit.pack();
    edit.resize(4*32,4*32+10);
    edit.show();
    editorOpen = true;
  }
}
public void reset() {}
public String portName(int port){ return port_name[port]; };
public String portInfor(int port){return ports_info[port]; };
public String nodeInfo(){return quick_info;  };
public String authorName(){return new String("The Duke's
Girlfriend"); };
```

```
    public String expirationDate(){ return new String("8/10/97"); };
    public String cost() { return new String("Demo"); };
    public String version(){ return new String("0.1"); };
    public boolean hasOwnThread() { return false; } ;
    public String componentURL() { return info_url; }
    public int componentID() { return 5556432; }
    public void disconnecting(int port) { }
    public void connecting(int port) { }
    public void load(String s) {
    }
    public String save() {
        return ""; }
    int request_index = 0, send_index = 0;
    public void run() {
                                            request_index=0;
send_index=0;
                    vj.request(0,request_index++,this);
  }

    public void request(int port,int time) {
    }
    public void set(Object o,int port,int time) {
      if(port==0) {
                try{
          // Send the message rec on input port 0 to server for
distribution to all
          // other connected clients
                client.write("SendAllClients(\"" + (String)o + "zzyx\")");
                }
                catch(Exception e){
                }
      }
          vj.request(0,request_index++,this);
    }
    public String name() { return name; }
    public void init(){       }
    public void start(){ };
    public void stop(){};
    public void destroy(){};
    public Image getNormalImage() { return normalImage; }
    public Image getSelectedImage(){ return selectedImage; };
    public int numberOfPorts(){ return numberOfPorts; };
    public int numberOfConnections(){ return 0; };
    public int portType(int i){ return port_type[i]; };
    public int portLocation(int i){ return port_location[i]; };
        public boolean handleEvent(Event e) {
          switch(e.id){
```

```
                case VJEvent.DOUBLECLICK: propertiesEditor(); break;
            }
            return false;
        }
}
class propsEditor extends Frame
{
    VJChat vjc;
    TextField tf;
    Button b;
    Button cancel;

  public propsEditor (Frame parent,VJChat c)
  {
     super("Enter name");
        setLayout(new BorderLayout());
        add("North",new Label("Name"));
        vjc = c;
        tf = new TextField(vjc.clientname);
        add("Center",tf);
        b = new Button("OK");
        cancel = new Button("Cancel");
        Panel sp = new Panel();
        sp.add(b);
     sp.add(cancel);
     add("South",sp);

  }

  public boolean handleEvent(Event evt)
  {     //   System.out.println(evt.toString());

     switch(evt.id){
        case Event.WINDOW_DESTROY:
        {
            vjc.editorOpen = false;
            dispose();
            return true;
        }
        case Event.ACTION_EVENT:
        {
           if("OK".equals(evt.arg))
           {    vjc.editorOpen = false;
              vjc.setName(tf.getText());
              dispose();
              return true;
           }
```

```
                    if("Cancel".equals(evt.arg))
                    {   vjc.editorOpen = false;
                        dispose();
                        return true;
                    }

                    return false;
                }
                default:
                    return false;
            }
        }

    }
    class auxClient{
      private AAuxClient writer;
      private DataInputStream in;
      private PrintStream out;
      private Socket server;
      static int SERVER_PORT = 4000;
      VJChat creator;
      visualJava vj;
      public auxClient(VJChat t, visualJava v){
            creator = t;
           vj = v;
        initSocket();
      }
      public void startUp(){
        AAuxClient reader = new AAuxClient(this, in, out);
            Thread t = new Thread(reader);
            t.setPriority(Thread.MIN_PRIORITY);
        writer = new AAuxClient(this, in, out);
            t.start();
      }
      public void write(String s){
        writer.send(s);
      }
      public void handleMessage(byte[] b){
        creator.handleMessage(b);
      }
      private void initSocket(){
        byte bytes[] = new byte[4096];
        int c;
        try{
          server = new Socket(vj.getDocumentBase().getHost(),
    SERVER_PORT);
          in = new DataInputStream(server.getInputStream());
```

```
      out = new PrintStream(server.getOutputStream());
    }
    catch(Exception e){
      try{
        server.close();
      }
      catch(Exception e2){
        System.err.println("Exception:\n" + e);
        //System.exit(1);
      }
      //System.exit(1);
    }
  }

}
class AAuxClient implements Runnable
{
      DataInputStream input = null;
      PrintStream output = null;
  auxClient creator;
  boolean inputValid = false;
      public AAuxClient(auxClient b, DataInputStream in,
PrintStream out){
        creator = b;
    input = in;
    output = out;
      }
      public void run(){
        String msg;
        int n;
    byte[] b = new byte[500];
        while(true){
            try{
       while(input.available() == 0){
         Thread.sleep(100);
       }
      }
            catch(Exception e){
              System.out.println("IO exception in run()");
            }
      b = receive();
            if(b.length == 0){
              return;
      }
      service(b);
    }
      }
```

```
public boolean send(byte b[], int length){
  try{
        output.write(b, 0, length);
    output.flush();
  }
     catch(Exception e){
   return false;
     }
     return true;
   }
public boolean send(String s){
  byte[] b = new byte[200];
  s.getBytes(0, s.length(), b, 0);
  return send(b, s.length());
}
private void service(byte msg[]){
  creator.handleMessage(msg);
    }
    private byte[] receive(){
      byte[] b = new byte[200];
  try{
   input.read(b);
  }
     catch(Exception e){
   return new byte[0];
     }
  return b;
    }
}
```

FIG. **20** illustrates a screen with the logical view in accordance with a preferred embodiment. A sound component **2000** has been instantiated on the logical view by dropping a sound icon onto the logical desktop **2010**.

FIG. **21** illustrates a screen with the logical and physical view preparing a hierarchical component in accordance with a preferred embodiment. A button **2120** has been instantiated and customized **2110** on the logical desktop **2114** and its physical representation **2100** is also reflected in the physical desktop **2112**.

FIG. **22** illustrates a screen with a connection made for playing a sound in accordance with a preferred embodiment. The button component **2200** is connected **2210** to the sound component **2220** in the logical desktop **2230**. The Play Sound Button component **2240** is the physical view in the physical desktop **2250**.

FIG. **23** illustrates an edit screen for a folder component utilized to prepare a hierarchical component in accordance with a preferred embodiment. A Container **1** folder **2300** is instantiated in the logical desktop **2350** by dropping a folder component **2360** on the desktop. A customize or edit window **2310** pops up when the folder is instantiated. This edit window can be utilized to change the name of the folder and the number, location and type of active ports of the folder component. The Container **1** folder is logically represented by a window **2320** where the logic of the folder (hierarchical component) can be created on the fly by adding or deleting components in the window **2320**. The button **2330** is also shown in the physical desktop **2340**.

As shown in FIG. **23**A, a folder class with options for unidirectional and bidirectional ports and an editor is first created as depicted by block **2370**. The user instantiates a folder component by dragging and dropping it onto the logical desktop **2350** as reflected by block **2372**. When the folder is instantiated and its edit window **2310** pops up, as described above, the folder name and the number, location and type of ports can be selected or changed. This capability is reflected in block **2374**. Finally, as shown by block **2376**, the folder component waits on the user to indicate what other components, including other folders, should be placed within it. This procedure is described hereafter in connection with FIG. **24**.

FIG. **24** illustrates a hierarchical component creation customization in accordance with a preferred embodiment. The button **2400** which was originally in the logical desktop **2420** has been moved into the Container **1** folder **2410**. The internal connectors **2430**C and **2440**C are represented in the Container **1** folder **2410** and refer back to the logical desktop ports **2440**L and **2430**L of the folder **2450** in the logical desktop **2420**. The ports can be used to transfer information into and out of a folder **2410**. One of ordinary skill in the art will readily recognize that other components could be added to the Container **1** folder **2410** to create a more complex hierarchical component which could even include nested and recursive hierarchical components.

FIG. **25** illustrates the completed physical view of a hierarchical component in accordance with a preferred embodiment. The sound button **2500** in the physical view **2520** is now inside the folder **2510** which can be used to simplify complex logic on the logical desktop **2530** and reduce screen clutter. This technique can be utilized to capture debugged components and component assemblies in a single representation of many components. Users can thus create their own components.

While the invention is described in terms of preferred embodiments in a specific system environment, those skilled in the art will recognize that the invention can be practiced, with modification, in other and different hardware and software environments within the spirit and scope of the appended claims.

What is claimed is:

1. A method of providing user editing of predetermined object oriented components used in an object oriented applet or application, said method comprising the steps of:

a) defining an editor window as a method for the class template of each editable component;

b) defining the properties and their limits for the editor window of each component;

c) opening the editor window without user intervention when an editable component is instantiated to permit editing of a component's properties by the user;

d) closing the editor window when the user is finished editing;

e) accepting the user's editing changes; and

f) displaying component property changes of the edited component made by the user when the editor window is closed.

2. The method according to claim **1** which includes the steps of monitoring the properties of editable components for an indication that the user wishes to re-edit one or more of those properties and generating and forwarding a signal indicative thereof to the editor window.

3. The method according to claim **2** which includes the step of reopening the editor window in response to receipt of a-re-editing request signal.

4. The method according to claim **3** which includes the steps of closing the editor window when the user is finished re-editing, accepting the user's re-editing changes and displaying component property re-editing changes made by the user.

5. The method according to claim **1** which includes the step of reopening the editor window in response to receipt of a-re-editing request signal.

6. The method according to claim **5** which includes the steps of closing the editor window when the user is finished re-editing, accepting the user's re-editing changes and displaying component property re-editing changes made by the user.

7. The method according to claim **1** which includes the steps of closing the editor window when the user is finished re-editing, accepting the user's re-editing changes and displaying component property re-editing changes made by the user.

8. A system for providing user editing of predetermined object oriented components used in an object oriented applet or application, said system comprising:

a) an editor window defined as a method of the class template of each predetermined editable component;

b) a list of the properties and their limits that are editable in each predetermined editable component;

c) logic for opening the editor window without user intervention when an editable component is instantiated to permit editing of that component's properties by the user;

d) logic for closing the editor window when the user is finished editing;

e) a message advising the edited component to accept the user's editing changes and what they were; and

f) a display when the editor window is closed of the edited component showing the property changes made thereto by the user.

9. The system according to claim 8 which additionally comprises a monitor that checks the properties of editable components for an indication that the user wishes to re-edit one or more of those properties and which generates and forwards a signal indicative of the re-editing request to the editor window.

10. The system according to claim 9 which additionally comprises logic for reopening the editor window in response to receipt of a re-editing request signal.

11. The system according to claim 10 which additionally comprises logic that closes the editor window when the user is finished re-editing, accepts the user's re-editing changes and displays component property re-editing changes made by the user.

12. The system according to claim 8 which additionally comprises a monitor that checks the properties of editable components for an indication that the user wishes to re-edit one or more of those properties and which generates and forwards a signal indicative of the re-editing request to the editor window.

13. The system according to claim 12 which additionally comprises logic for reopening the editor window in response to receipt of a re-editing request signal.

14. The system according to claim 8 which additionally comprises logic for reopening the editor window in response to receipt of a re-editing request signal.

15. A computer program embodied on a computer-readable medium for providing user editing of predetermined object oriented components used in an object oriented applet or application, said embodied program comprising:

a) first software that defines an editor window as a method for the class template of each editable component;

b) second software that defines the properties and their limits for the editor window of each component;

c) third software that opens the editor window without user intervention when an editable component is instantiated to permit editing of a component's properties by the user;

d) fourth software that closes the editor window when the user is finished editing;

e) fifth software that accepts the user's editing changes; and

f) sixth software that displays the edited component's property changes made by the user when the editor window is closed.

16. The computer program embodied on a computer-readable medium as recited in claim 15 which additionally comprises seventh software for monitoring the properties of editable components for an indication that the user wishes to re-edit one or more of those properties and for generating and forwarding a signal indicative of the re-editing request to the editor window.

17. The computer program embodied on a computer-readable medium as recited in claim 16 which additionally comprises eighth software for reopening the editor window in response to receipt of a-re-editing request signal.

18. The computer program embodied on a computer-readable medium as recited in claim 17 which additionally comprises ninth software for closing the editor window when the user is finished re-editing, accepting the user's re-editing changes and displaying component property re-editing changes made by the user.

19. The computer program embodied on a computer-readable medium as recited in claim 15 which additionally comprises seventh software for reopening the editor window in response to receipt of a-re-editing request signal.

20. The computer program embodied on a computer-readable medium as recited in claim 19 which additionally comprises eighth software for closing the editor window when the user is finished re-editing, accepting the user's re-editing changes and displaying component property re-editing changes made by the user.

* * * * *